

Organized under Joint U.S. Communications Board

National Bureau of Standards
AUG 21 1947NOMOGRAPHIC PREDICTIONS OF F2-LAYER FREQUENCIESTHROUGHOUT THE SOLAR CYCLE, FOR JANUARY

The accompanying nomograms present predictions of f^oF_2 and F_2-4000 muf throughout the solar cycle, for each ten degrees of latitude in each of the three zones of Fig. 1.

These were derived in the manner described in the reports IRPL-R11, "A Nomographic Method for Both Prediction and Observation Correlation of Ionosphere Characteristics", and IRPL-R16, "Predicted F2-Layer Frequencies Throughout the Solar Cycle, for Summer, Winter, and Equinox Season". The method of their use in obtaining f^oF_2 and F_2-4000 muf is illustrated by the example shown on Fig. 45. The use of these quantities in obtaining the muf for high-frequency radio propagation is discussed in the report IRPL-R16, cited above, and in the IRPL Radio Propagation Handbook, Part 1, p.47 et seq. It is to be noted that the values of f^oF_2 and F_2-4000 muf obtained by means of these nomograms must be complemented by values of E-layer muf, in the case of transmission paths under 4000 km and by sporadic-E transmission frequencies for all paths, especially those passing near the auroral zones shown in Fig. 1. This is particularly important during times of minimum solar activity.

Values of f^oF_2 obtained by means of these nomograms should be fairly accurate in the proximity of ionosphere observing stations which have been in operation for a long time, such as those at Washington, D.C., Watheroo, W. Australia, and Huancayo, Peru. Inaccuracy of prediction is most likely in equatorial regions, where the latitude gradient of f^oF_2 is particularly high, and in the W zone south of Huancayo, Peru ($12^\circ S$), where a few ionospheric observations have been made and thus the prediction is based upon observations in other zones.

The small convolutions of the central curves, A, which show the variation of f^oF_2 , are frequently of doubtful significance, since many of them may be less than the error or prediction. No attempt was made to smooth these out, however, because of lack of exact knowledge of the extent of this error.

Values of F_2-4000 muf obtained from these nomograms are likely to be slightly too high during periods of high sunspot number, since the values of $F_2-M(3000)$ used in their computation, the average of all available data, were those obtained during years of low solar activity, and there is a slight decrease in these values with increase of sunspot number. It is estimated that the amount of this error, at a sunspot number of 100, is about 5%.

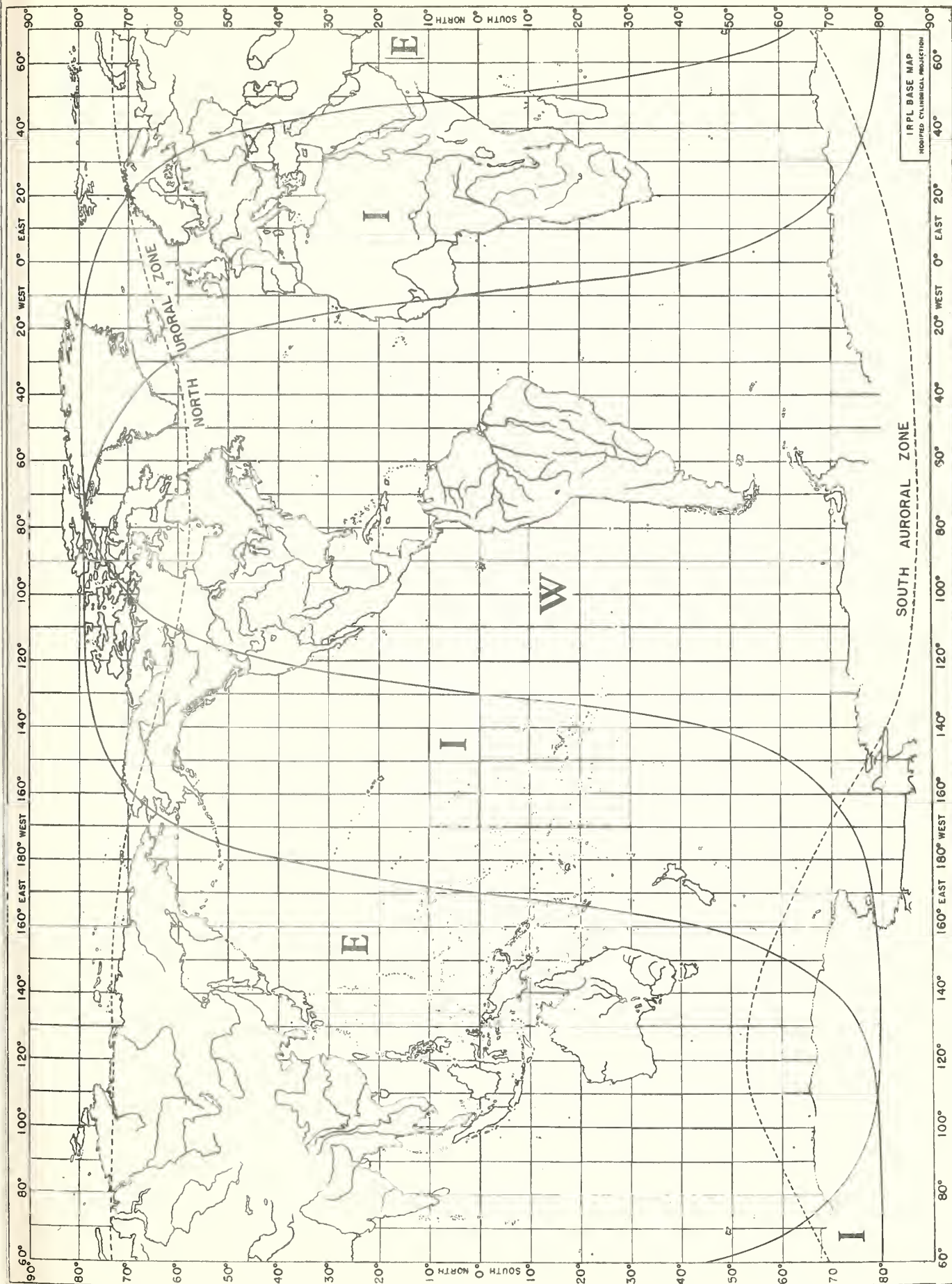
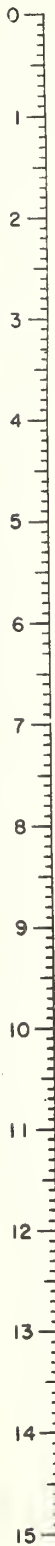
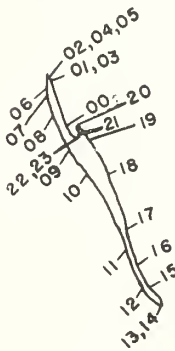


Fig. 1. WORLD MAP SHOWING ZONES COVERED BY PREDICTED CHARTS, AND AURORAL ZONES.

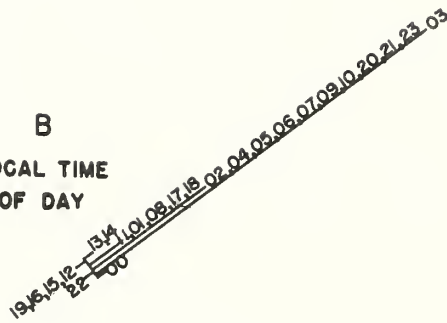
$f^{\circ}F_2$,
Mc



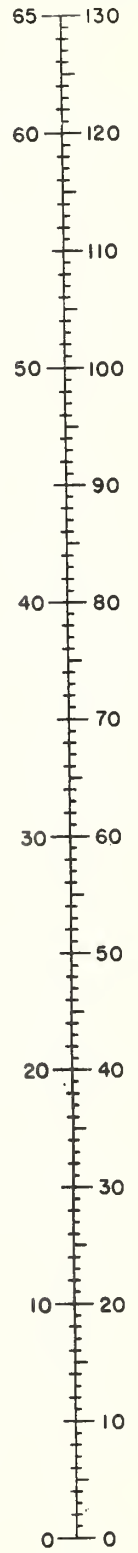
A
LOCAL TIME
OF DAY



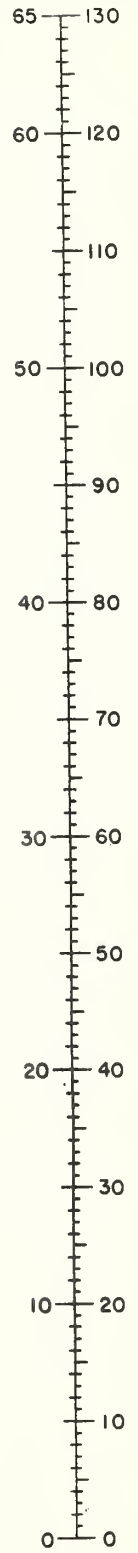
B
LOCAL TIME
OF DAY



F2-4000 MUF,
Mc



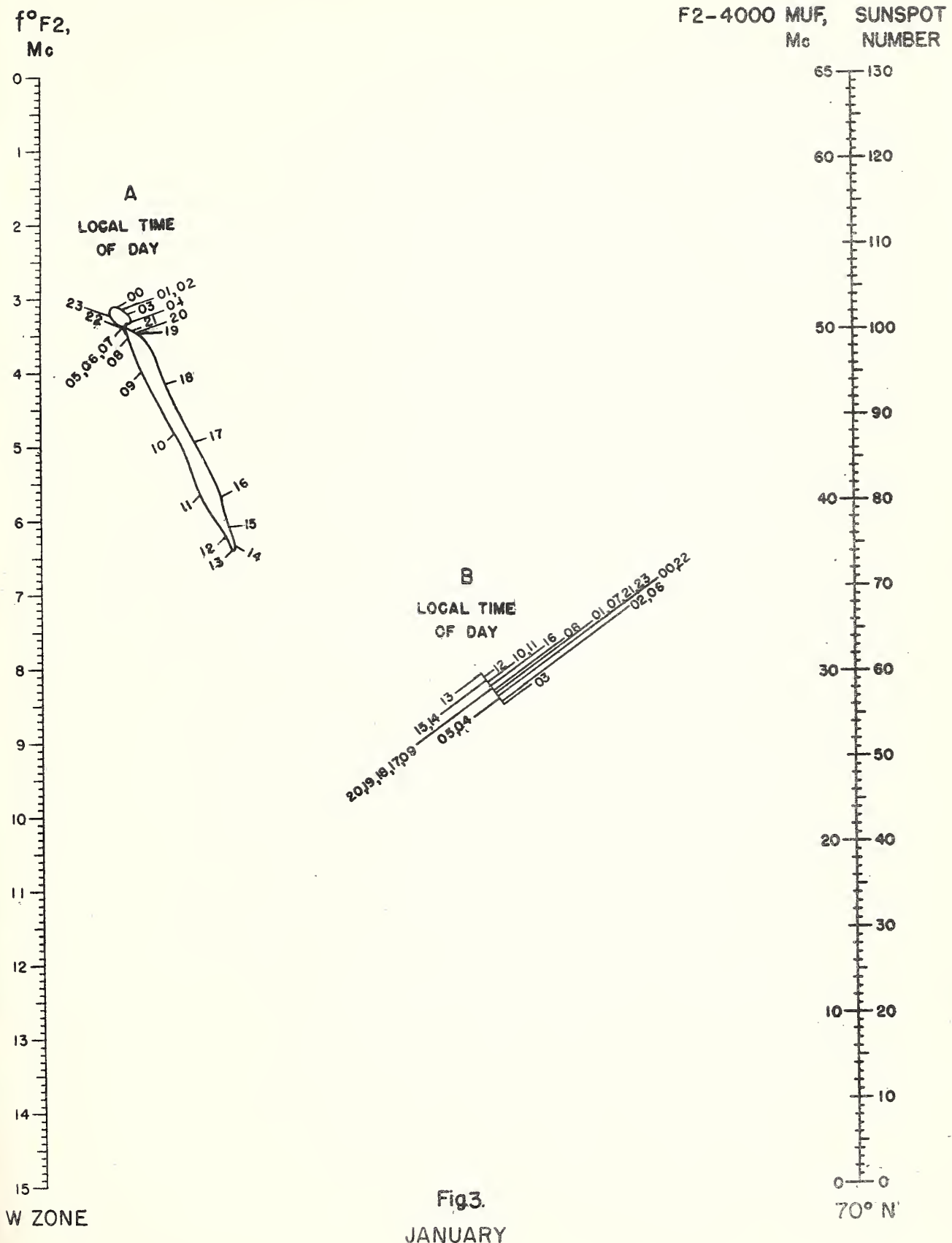
SUNSPOT
NUMBER



W ZONE

Fig.2.
JANUARY

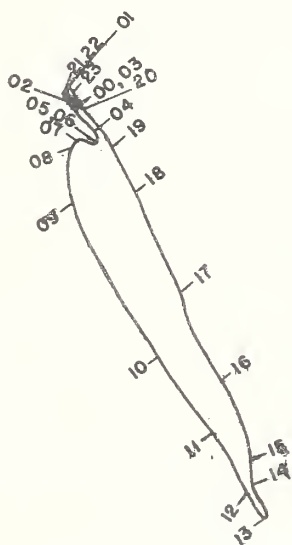
80° N



f^oF_2 ,
Mc

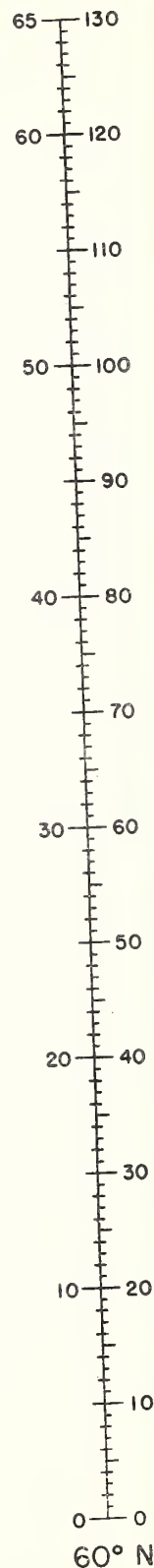


A
LOCAL TIME
OF DAY



W ZONE

F2-4000 MUF,
Mc SUNSPOT
NUMBER



B
LOCAL TIME
OF DAY

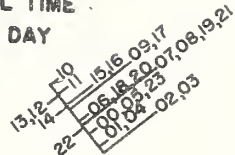
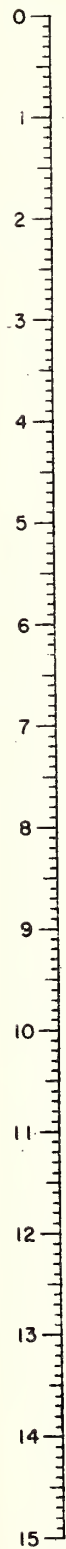


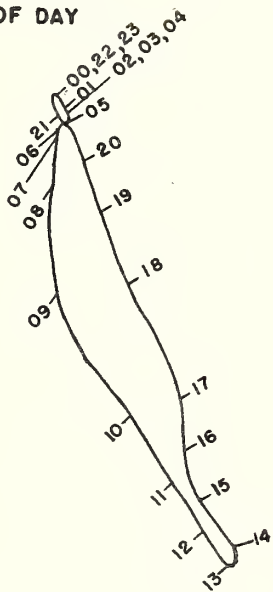
Fig.4.
JANUARY

$f^{\circ}F_2$,
Mc

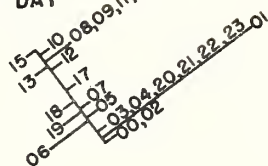


W ZONE

A
LOCAL TIME
OF DAY



B
LOCAL TIME
OF DAY



F2-4000 MUF, SUNSPOT
Mc NUMBER

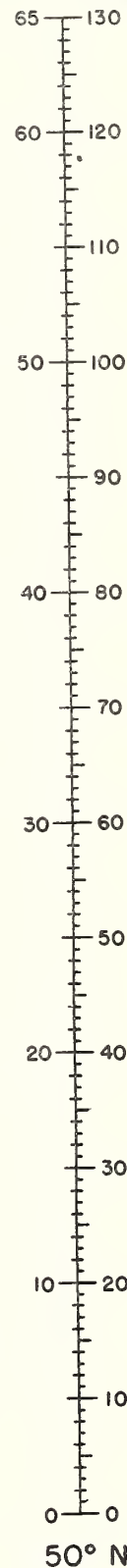


Fig. 5.
JANUARY



W ZONE

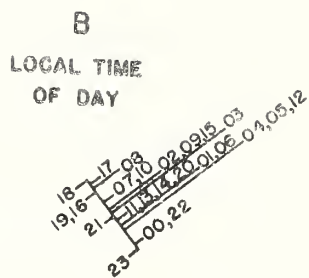
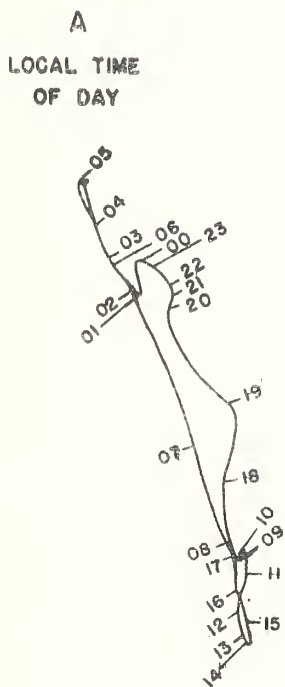
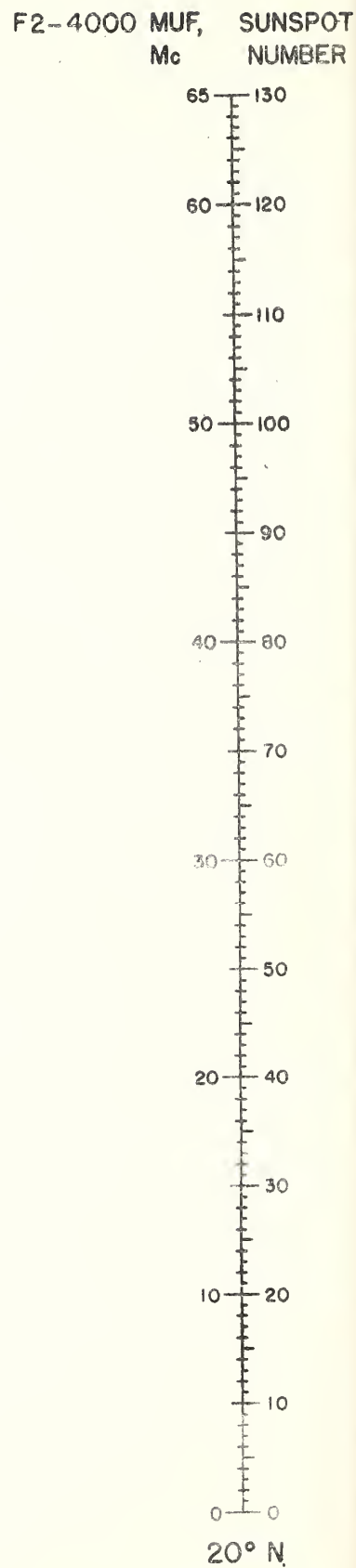
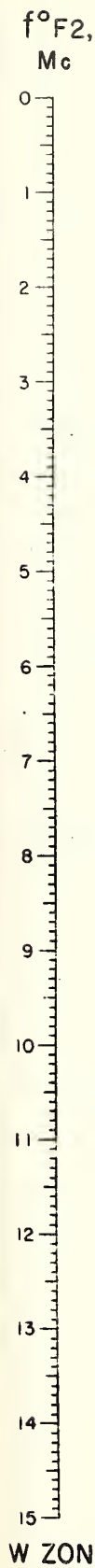


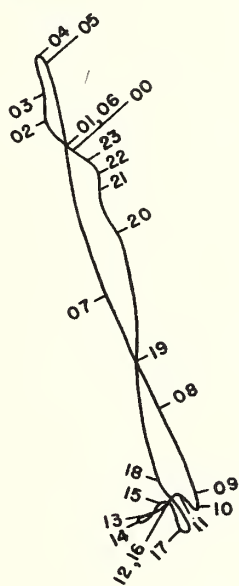
Fig. 8.
JANUARY





W ZONE

A
LOCAL TIME
OF DAY



B
LOCAL TIME
OF DAY

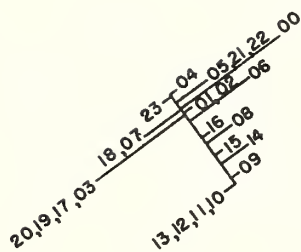
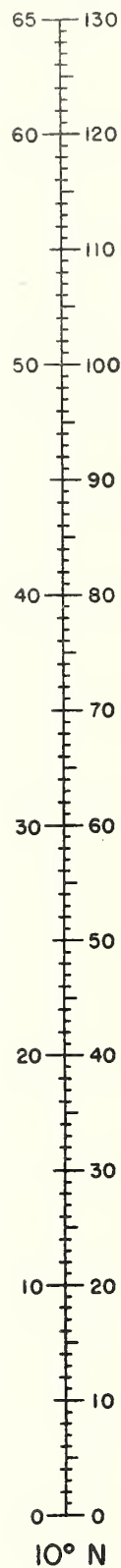


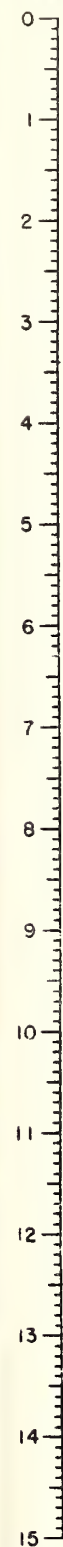
Fig.9
JANUARY

F2-4000 MUF,
Mc

SUNSPOT
NUMBER

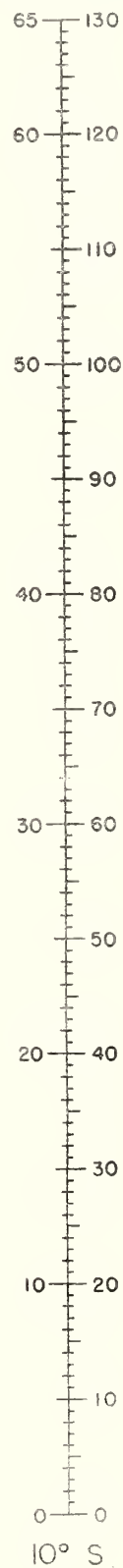


$f^{\circ}F_2$,
Mc



W ZONE

F2-4000 MUF,
Mc



SUNSPOT
NUMBER

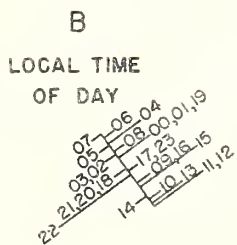
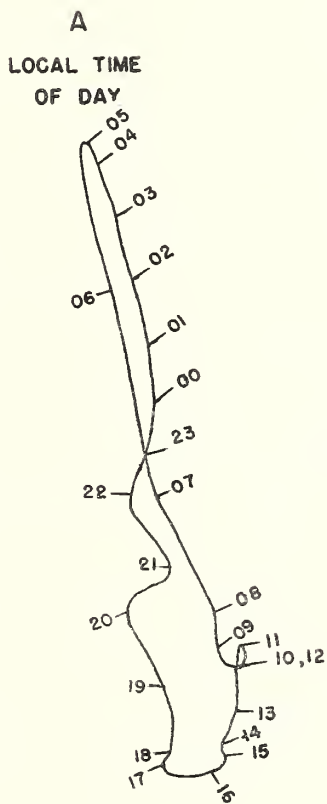


Fig. 11.
JANUARY

$f^{\circ}F_2$,
M_c



W ZONE

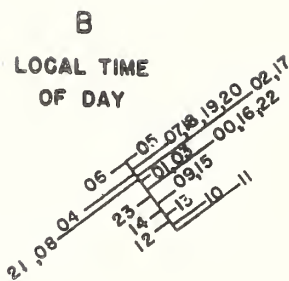
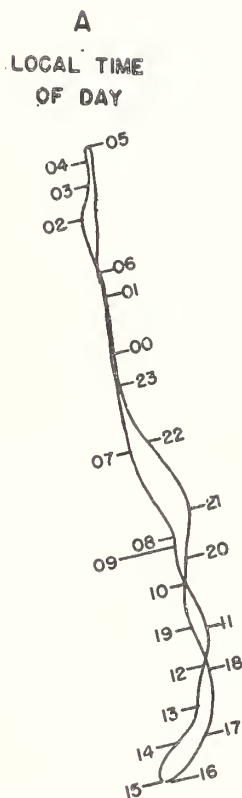
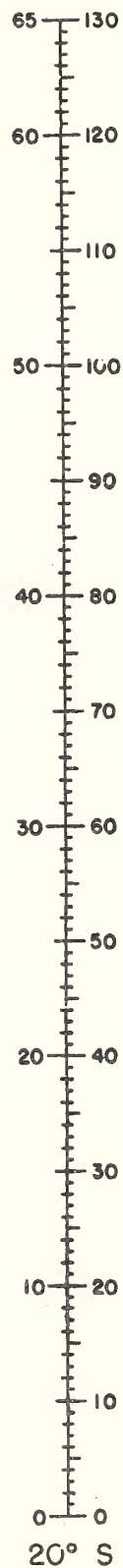


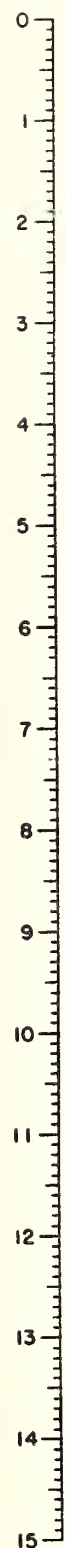
Fig. 12.
JANUARY

F2-4000 MUF, SUNSPOT
M_c NUMBER



20° S

$f^{\circ}F_2$,
Mc



W ZONE

F2-4000 MUF, SUNSPOT
Mc NUMBER

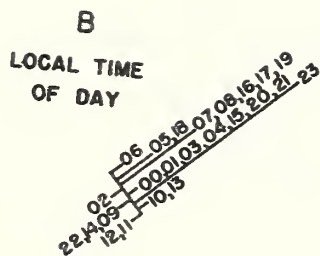
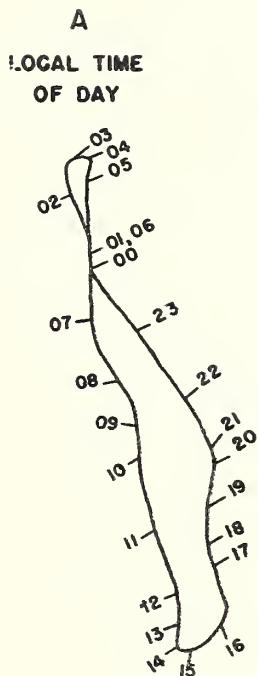
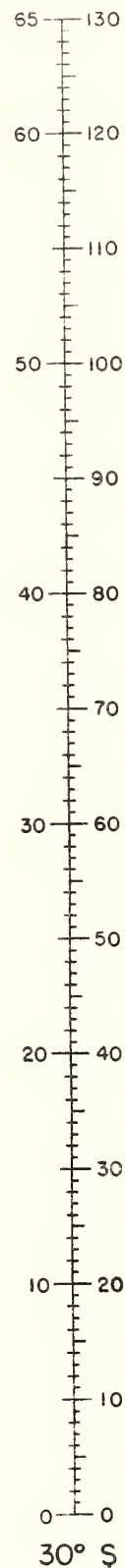
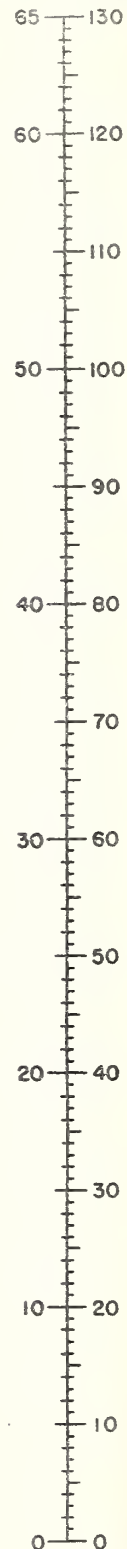
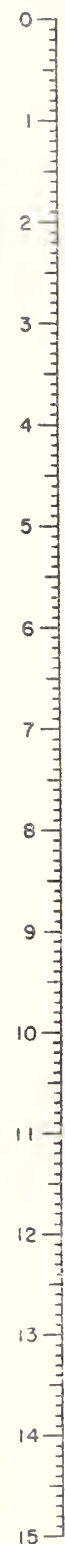


Fig.13.
JANUARY

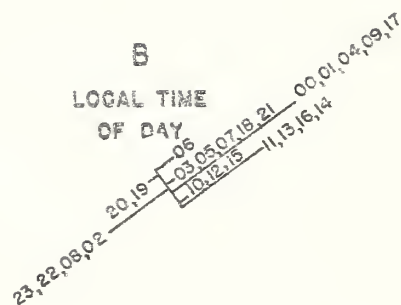
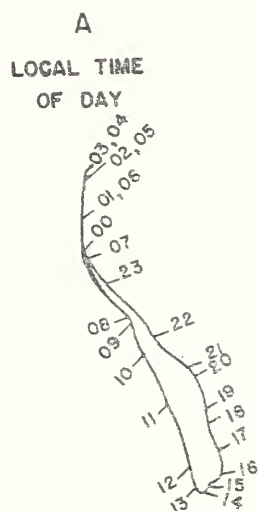
f^oF_2 ,
Mc

F2-4000 MUF,
Mc

SUNSPOT
NUMBER

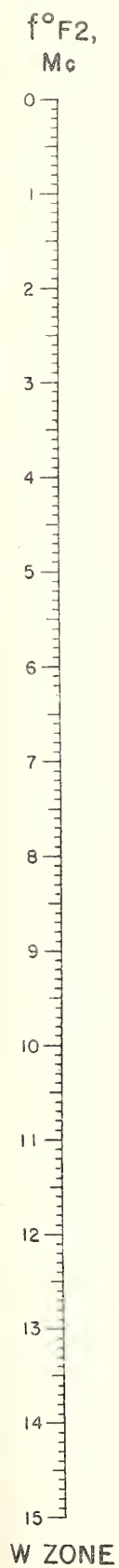


40° S



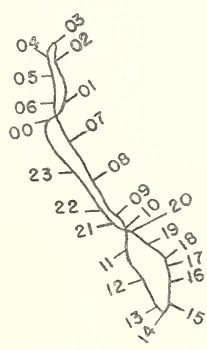
W ZONE

Fig.14
JANUARY



W ZONE

A
LOCAL TIME
OF DAY



B
LOCAL TIME
OF DAY

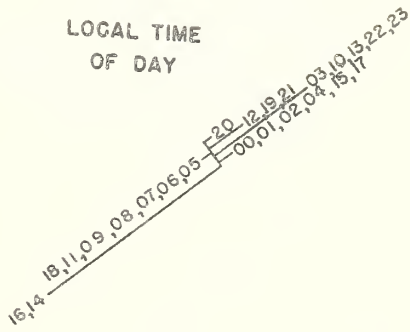
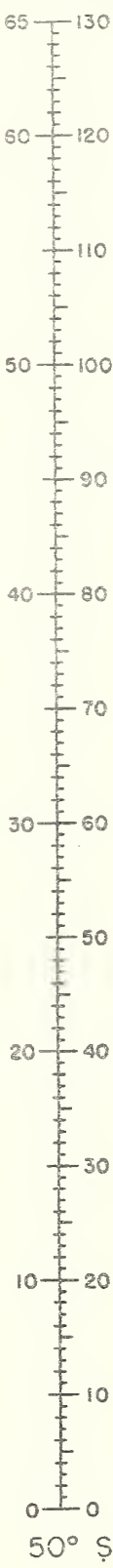


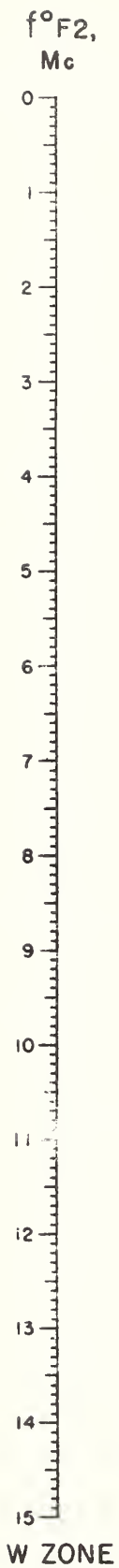
Fig. 15.
JANUARY

F2-4000 MUF,
Mc

SUNSPOT
NUMBER



50° S



W ZONE

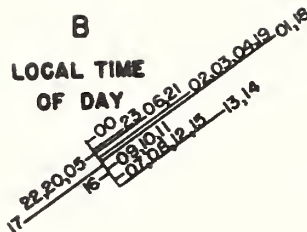
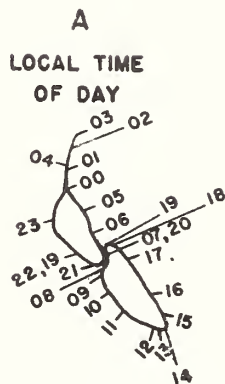
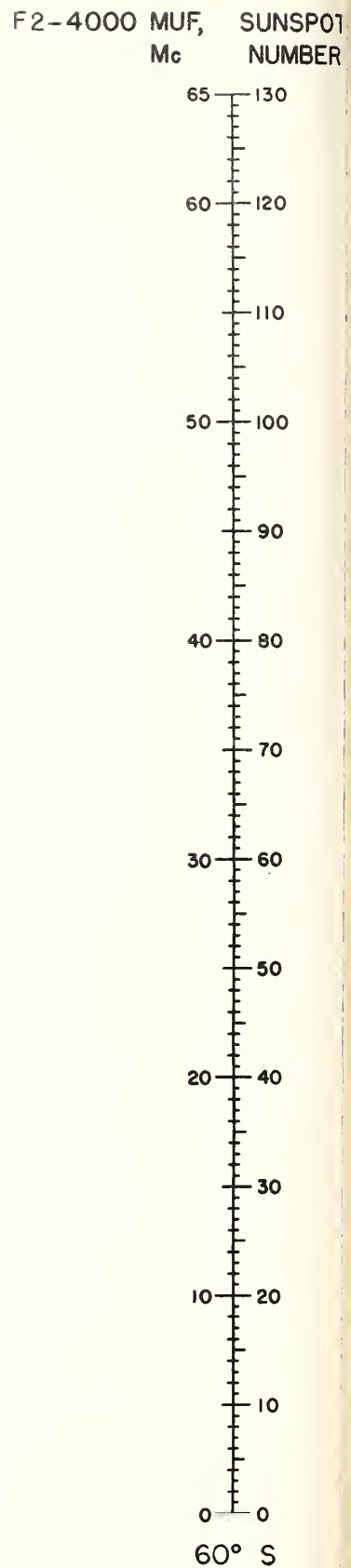


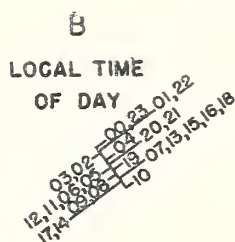
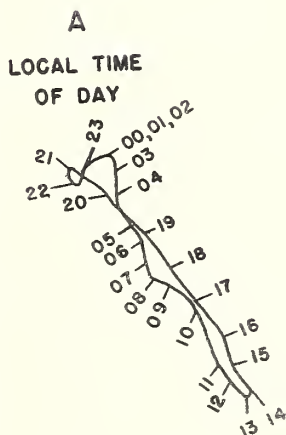
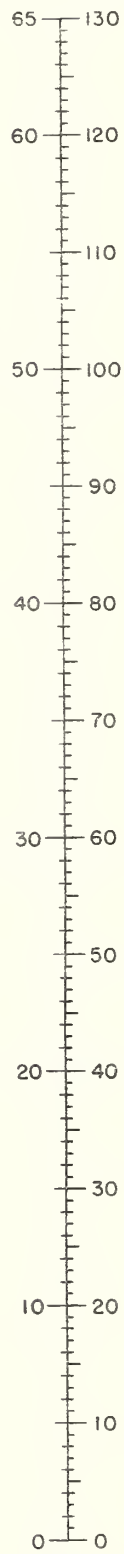
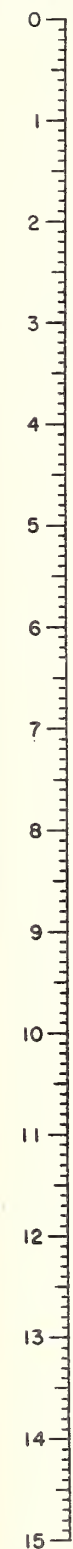
Fig. 16
JANUARY



f^oF_2 ,
Mc

F2-4000 MUF,
Mc

SUNSPOT
NUMBER



W ZONE

Fig.17.
JANUARY

70° S

f^oF_2 ,
Mc



W ZONE,
I ZONE

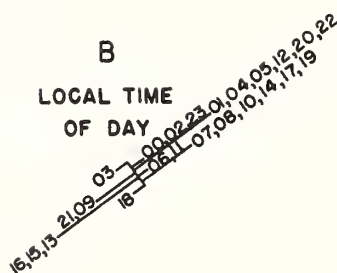
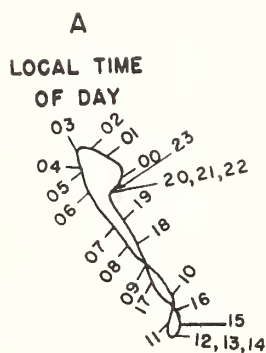
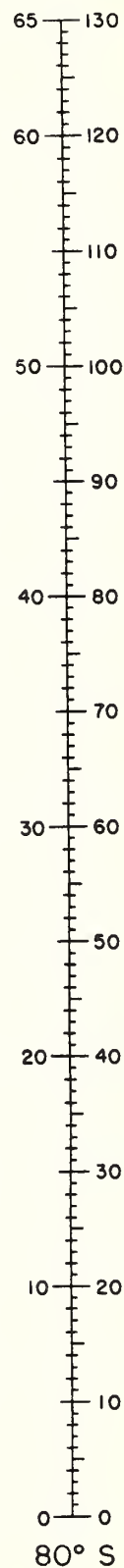
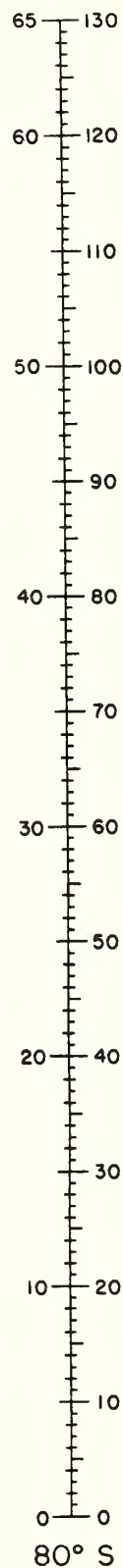


Fig. 18.
JANUARY

F2-4000 MUF,
Mc



SUNSPOT
NUMBER



f^oF_2 ,
Mc



I ZONE

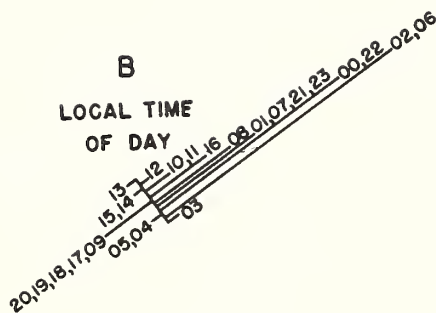
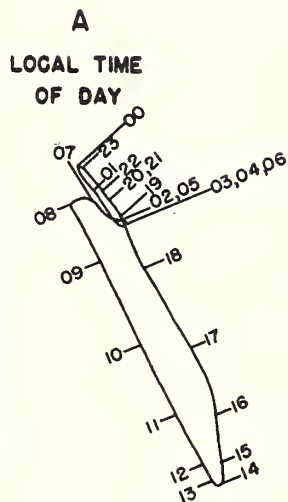
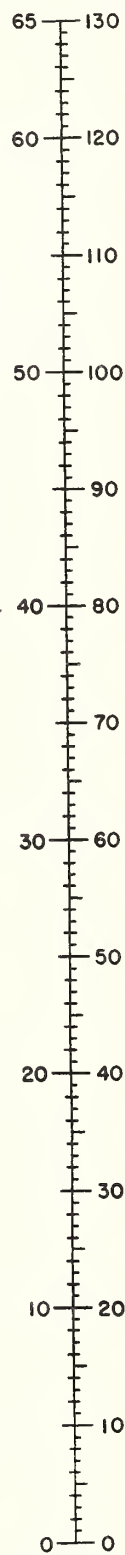
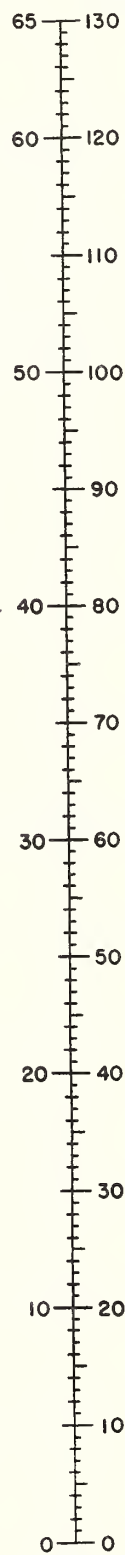


Fig.19.
JANUARY

F2-4000 MUF,
Mc



SUNSPOT
NUMBER



70° N

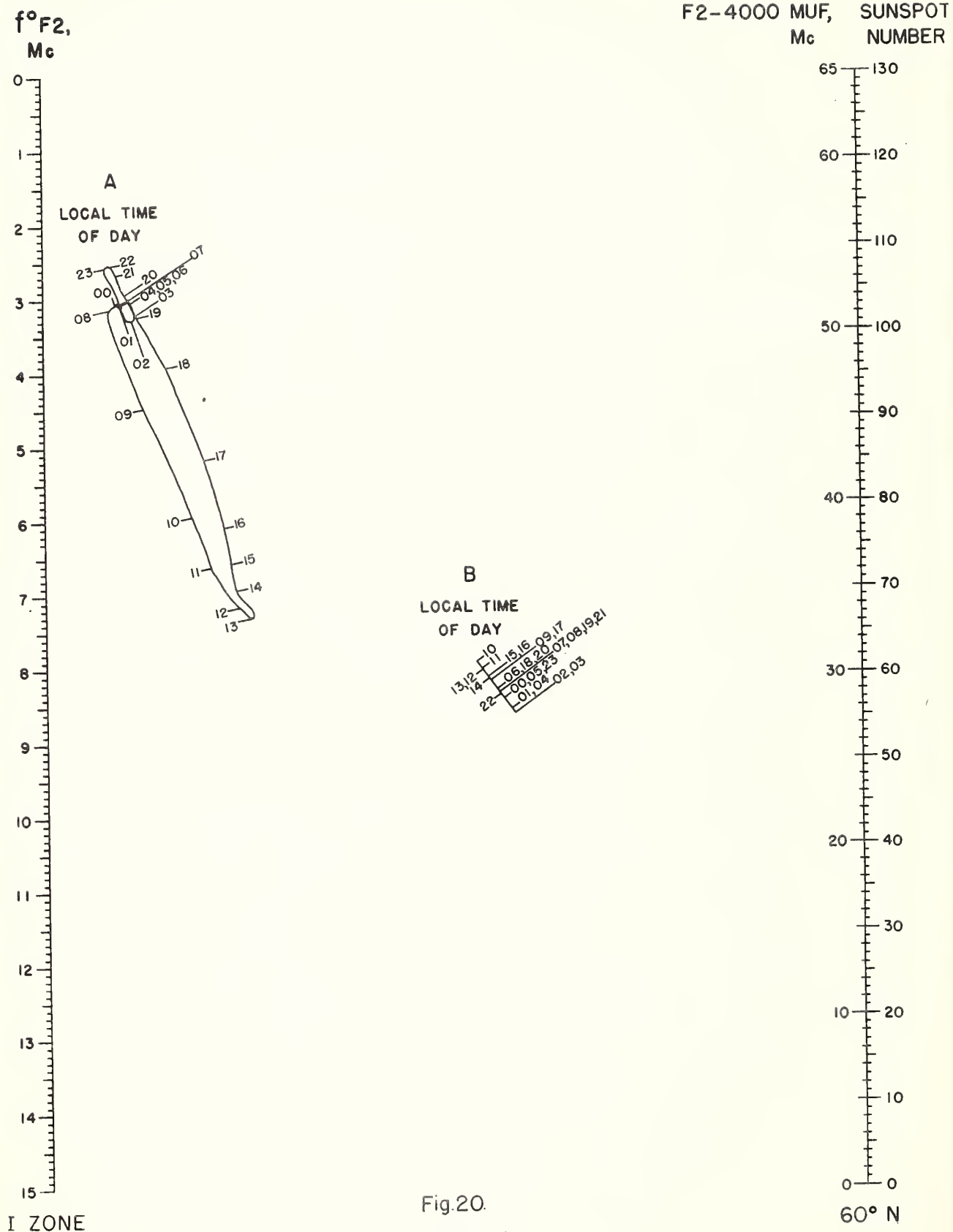


Fig.20.
JANUARY

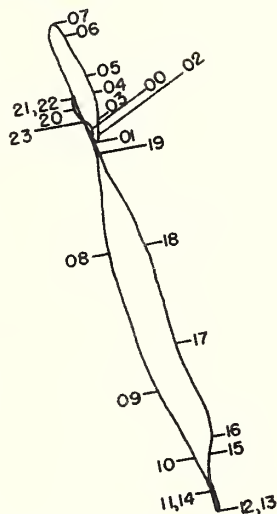
A vertical scale with major tick marks labeled from 0 to 15. Between each major tick mark, there are four smaller, unlabeled tick marks, dividing each unit into five equal intervals.

I ZONE

F2-4000 MUF, SUNSPOT
 Mc NUMBER

50° N

A
LOCAL TIME
OF DAY



B
LOCAL TIME
OF DAY

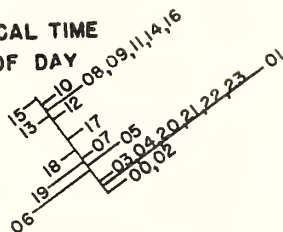
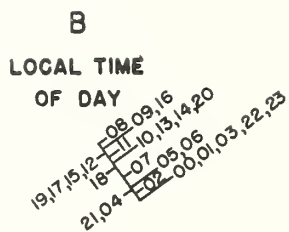
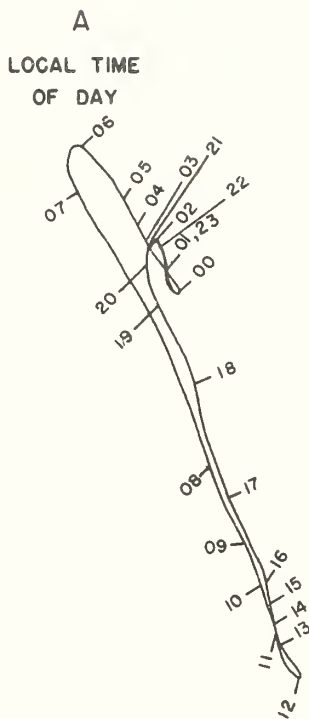


Fig. 21
JANUARY

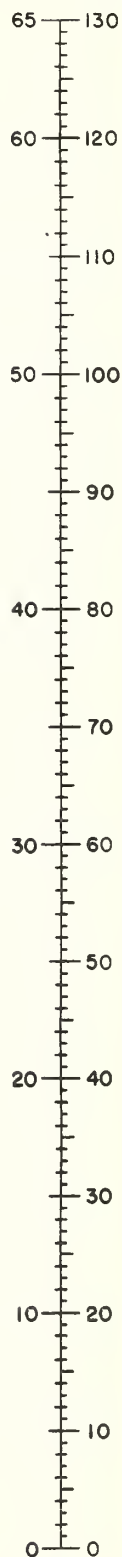
f^oF_2 ,
Mc



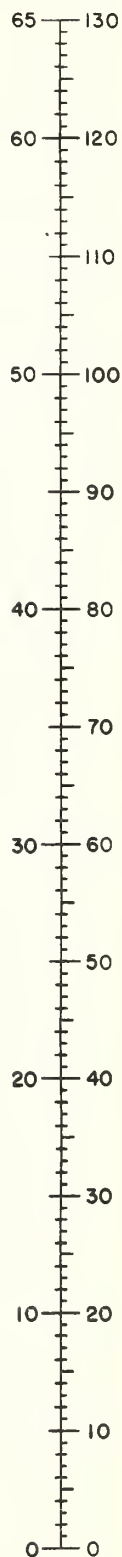
I ZONE



F2-4000 MUF,
Mc



SUNSPOT
NUMBER



40° N

Fig.22.
JANUARY

$f^{\circ}F_2$,
Mc



I ZONE

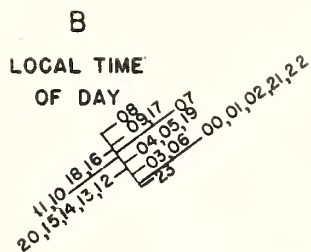
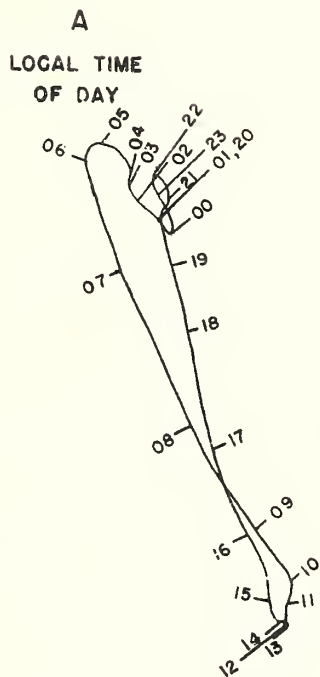
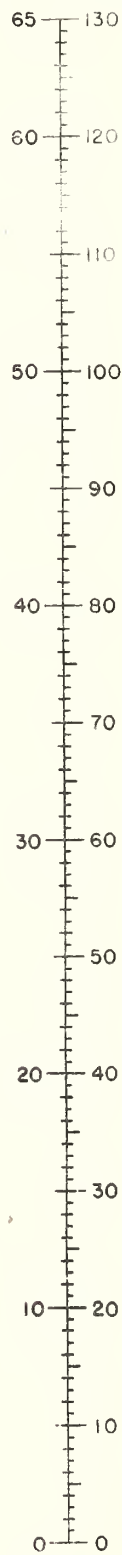
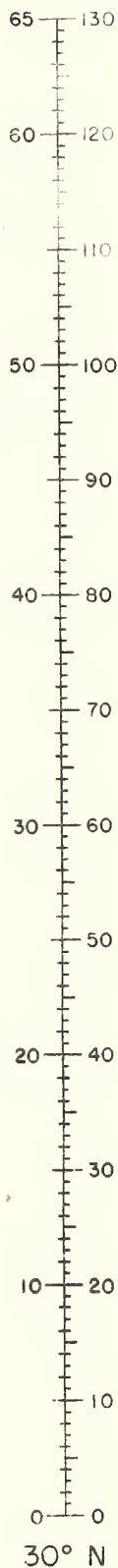


Fig. 23
JANUARY

F2-4000 MUF,
Mc



SUNSPOT
NUMBER



30° N

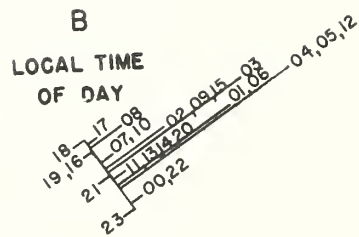
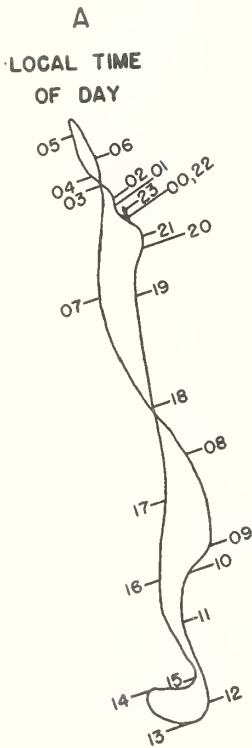
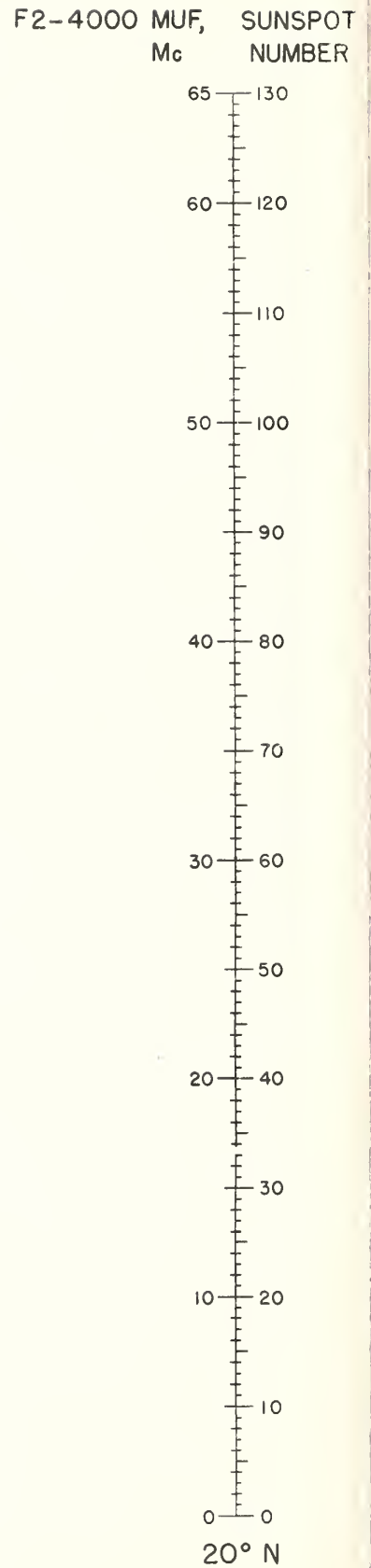


Fig. 24.
JANUARY

f^oF_2 ,
M_c

F2-4000 MUF,
M_c SUNSPOT
NUMBER

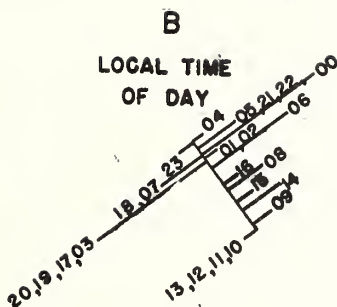
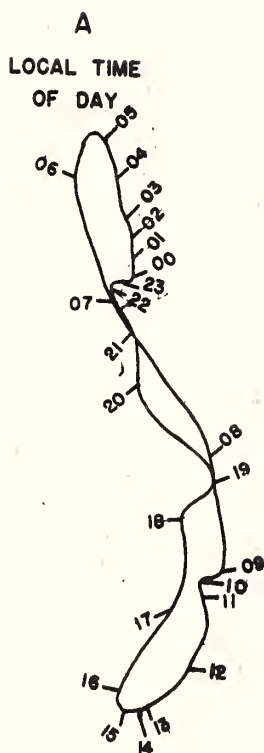
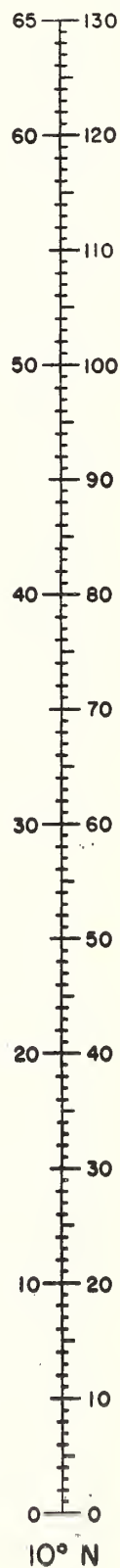


Fig.25.
JANUARY

I ZONE

10° N

I ZONE

F2-4000 MUF, SUNSP
Mc NUMBER

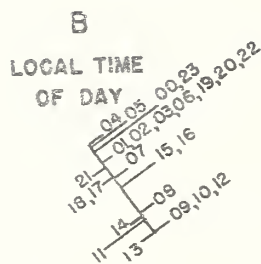
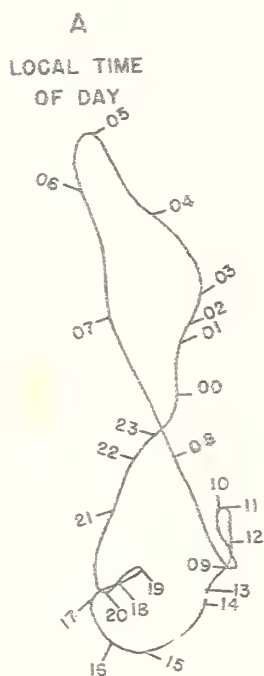
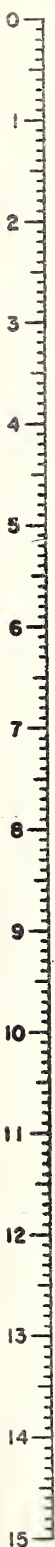
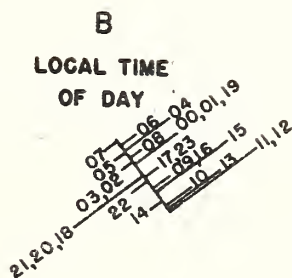
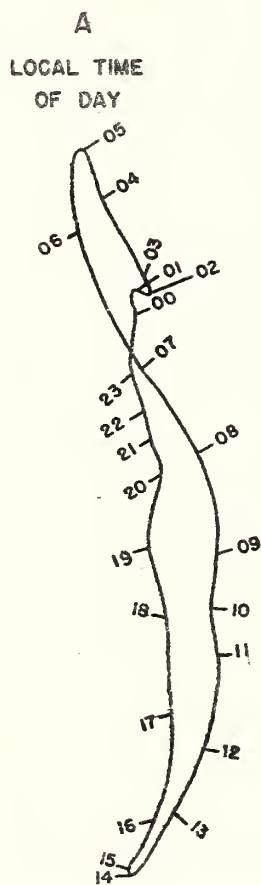
U^v

Fig.26.
JANUARY

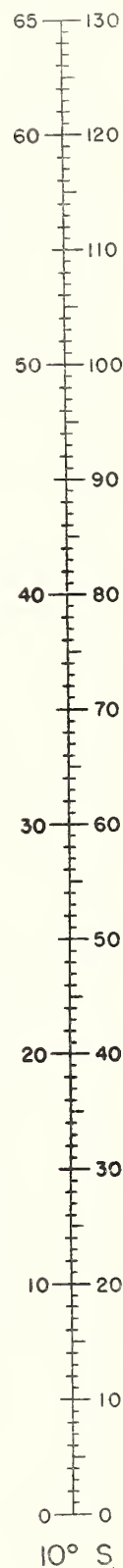
f^oF_2 ,
Mc



I ZONE



F2-4000 MUF,
Mc



SUNSPOT
NUMBER

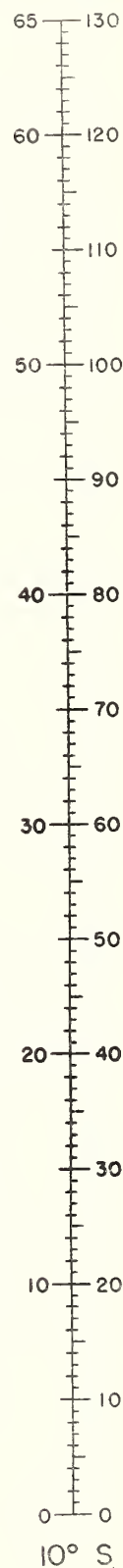
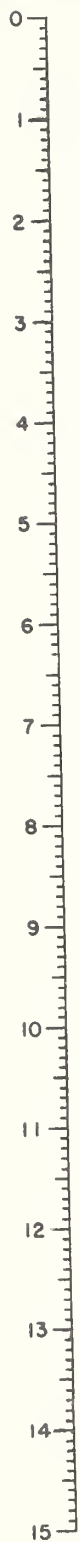


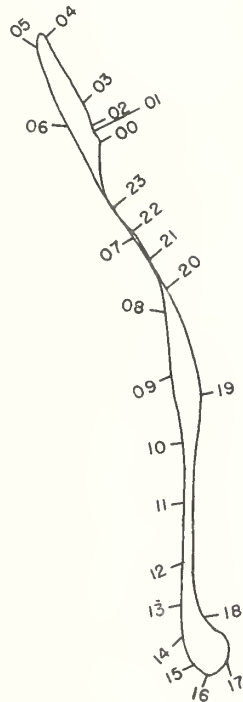
Fig.27.
JANUARY

$f^{\circ}F_2$,
Mc

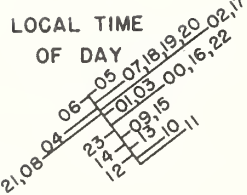


I ZONE

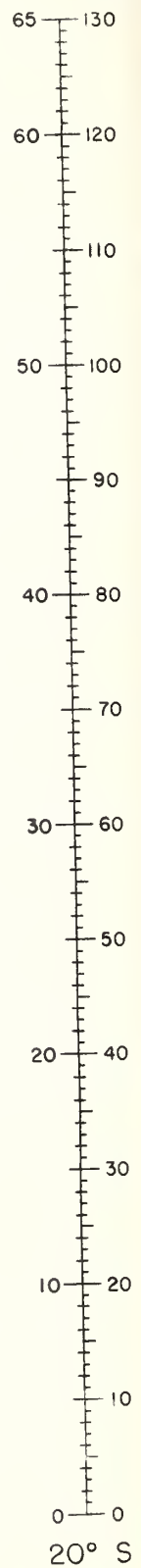
A
LOCAL TIME
OF DAY



B

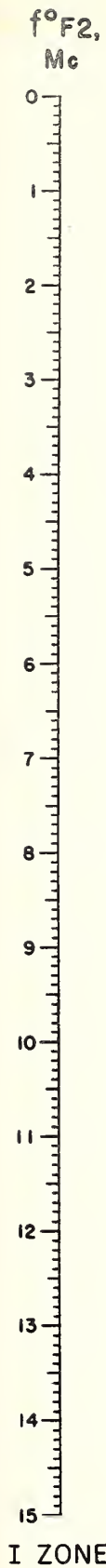


F2-4000 MUF, SUNSPOT
Mc NUMBER



20° S

Fig.28.
JANUARY



I ZONE

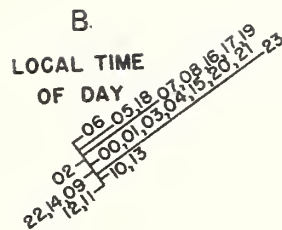
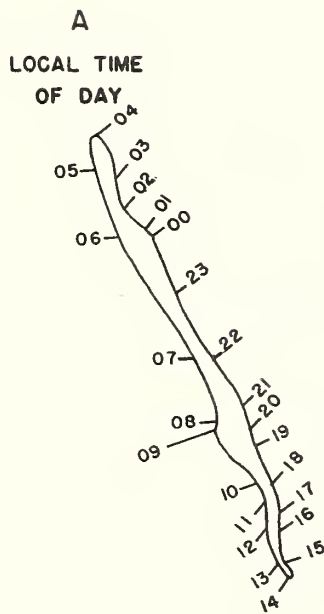
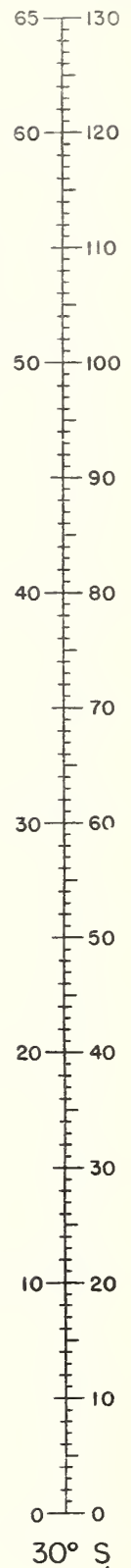


Fig.29.
JANUARY

F2-4000 MUF, SUNSPOT
Mc NUMBER



f^oF_2 ,
Mc



F2-4000 MUF, SUNCSPOT
Mc NUMBER

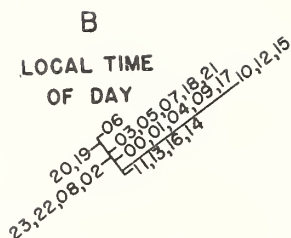
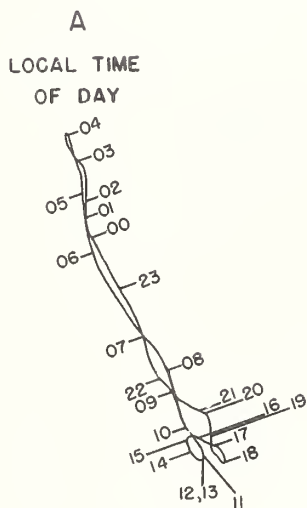
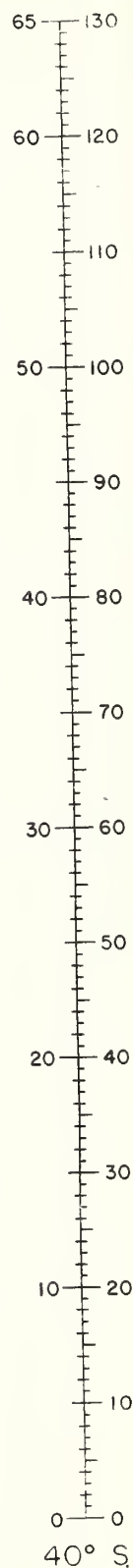
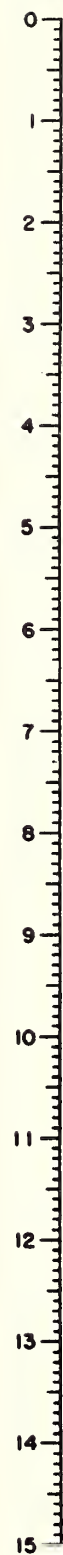


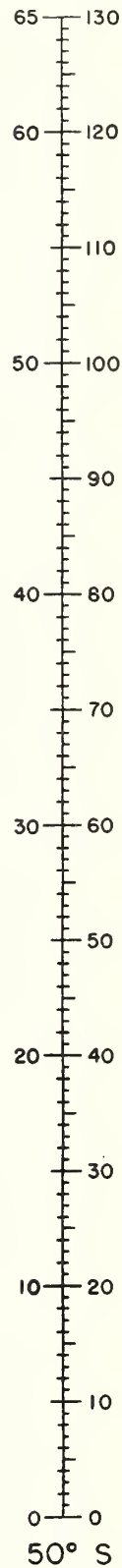
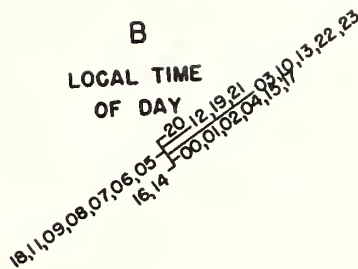
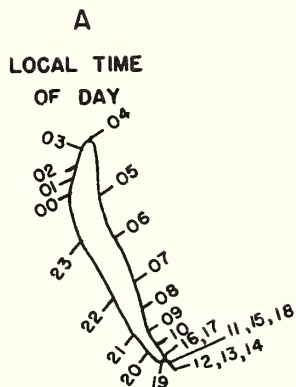
Fig.30.
JANUARY

I ZONE

F2-4000 MUF, Mc	SUNSPOT NUMBER
1.8	100
2.0	100
2.2	100
2.4	100
2.6	100
2.8	100
3.0	100
3.2	100
3.4	100
3.6	100
3.8	100
4.0	100
4.2	100
4.4	100
4.6	100
4.8	100
5.0	100
5.2	100
5.4	100
5.6	100
5.8	100
6.0	100
6.2	100
6.4	100
6.6	100
6.8	100
7.0	100
7.2	100
7.4	100
7.6	100
7.8	100
8.0	100
8.2	100
8.4	100
8.6	100
8.8	100
9.0	100
9.2	100
9.4	100
9.6	100
9.8	100
10.0	100
10.2	100
10.4	100
10.6	100
10.8	100
11.0	100
11.2	100
11.4	100
11.6	100
11.8	100
12.0	100
12.2	100
12.4	100
12.6	100
12.8	100
13.0	100
13.2	100
13.4	100
13.6	100
13.8	100
14.0	100
14.2	100
14.4	100
14.6	100
14.8	100
15.0	100
15.2	100
15.4	100
15.6	100
15.8	100
16.0	100
16.2	100
16.4	100
16.6	100
16.8	100
17.0	100
17.2	100
17.4	100
17.6	100
17.8	100
18.0	100
18.2	100
18.4	100
18.6	100
18.8	100
19.0	100
19.2	100
19.4	100
19.6	100
19.8	100
20.0	100
20.2	100
20.4	100
20.6	100
20.8	100
21.0	100
21.2	100
21.4	100
21.6	100
21.8	100
22.0	100
22.2	100
22.4	100
22.6	100
22.8	100
23.0	100
23.2	100
23.4	100
23.6	100
23.8	100
24.0	100
24.2	100
24.4	100
24.6	100
24.8	100
25.0	100
25.2	100
25.4	100
25.6	100
25.8	100
26.0	100
26.2	100
26.4	100
26.6	100
26.8	100
27.0	100
27.2	100
27.4	100
27.6	100
27.8	100
28.0	100
28.2	100
28.4	100
28.6	100
28.8	100
29.0	100
29.2	100
29.4	100
29.6	100
29.8	100
30.0	100
30.2	100
30.4	100
30.6	100
30.8	100
31.0	100
31.2	100
31.4	100
31.6	100
31.8	100
32.0	100
32.2	100
32.4	100
32.6	100
32.8	100
33.0	100



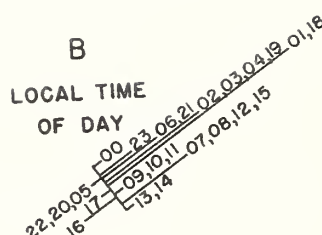
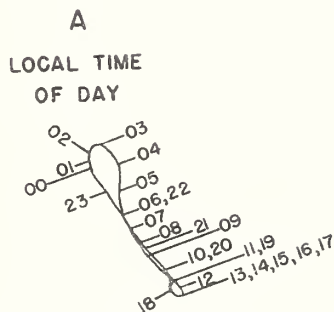
I ZONE



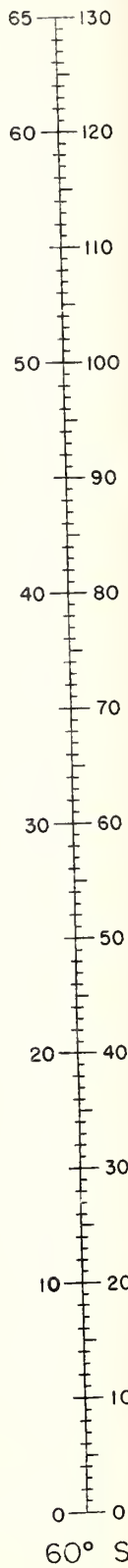
50° S

Fig. 31.
JANUARY

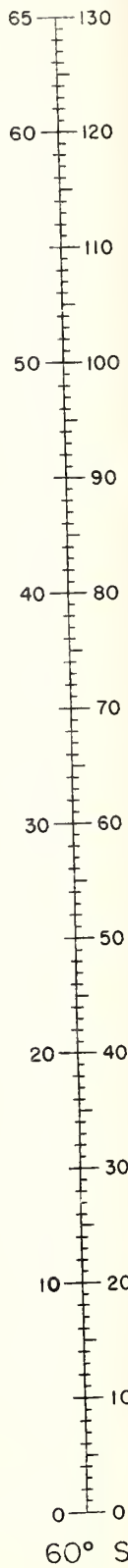
$f^{\circ}F_2$,
Mc



F2-4000 MUF,
Mc



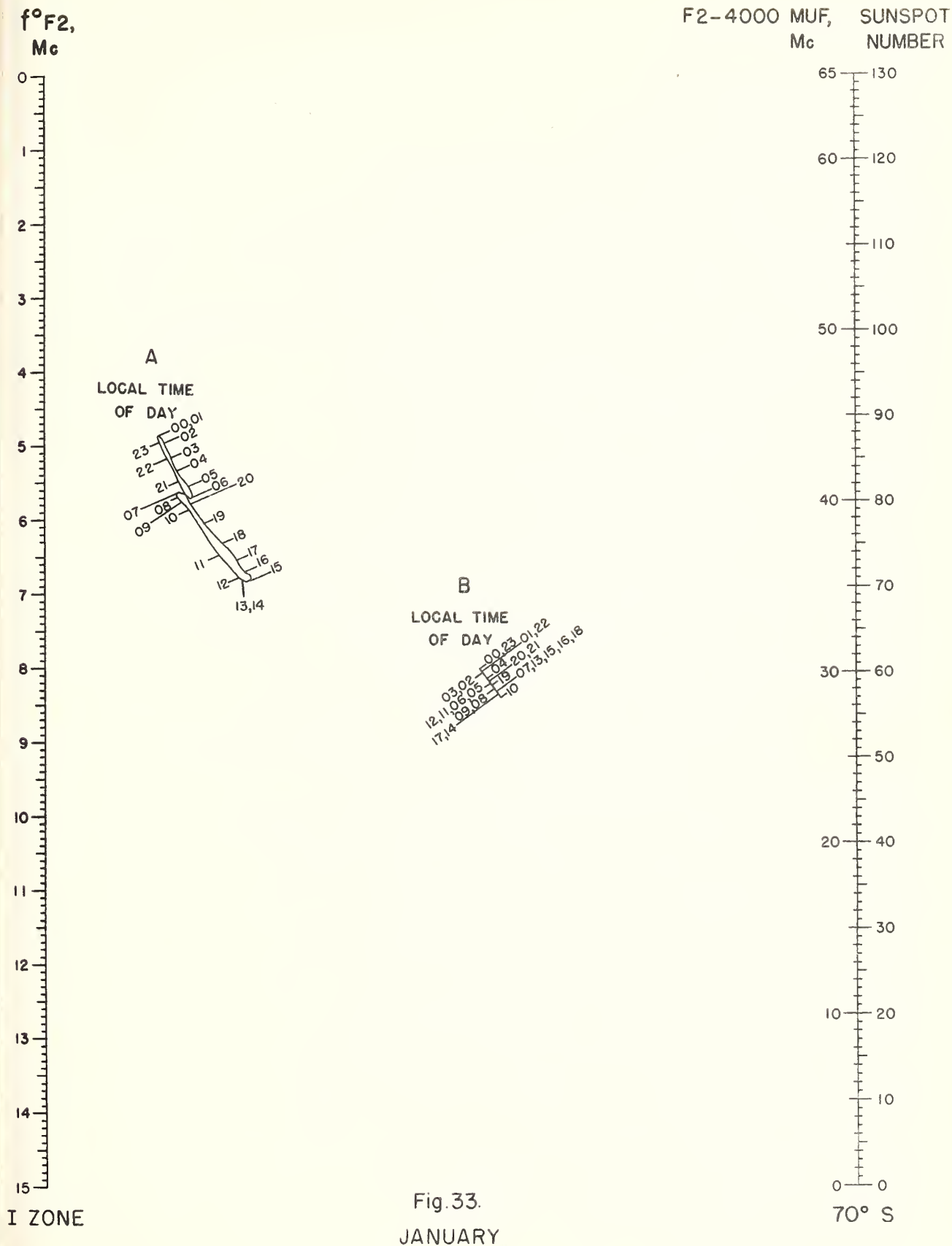
SUNSPOT
NUMBER

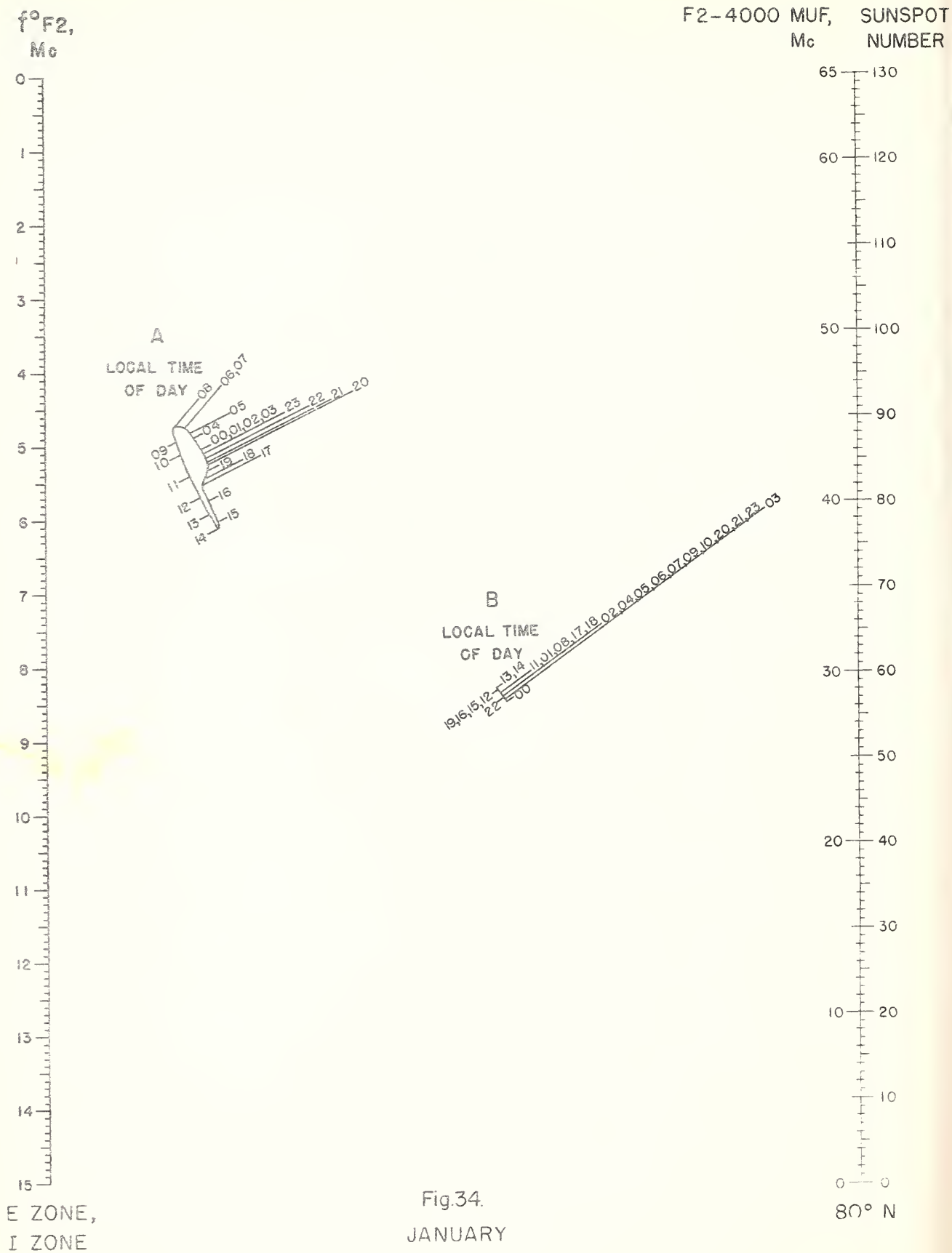


I ZONE

Fig.32.
JANUARY

60° S





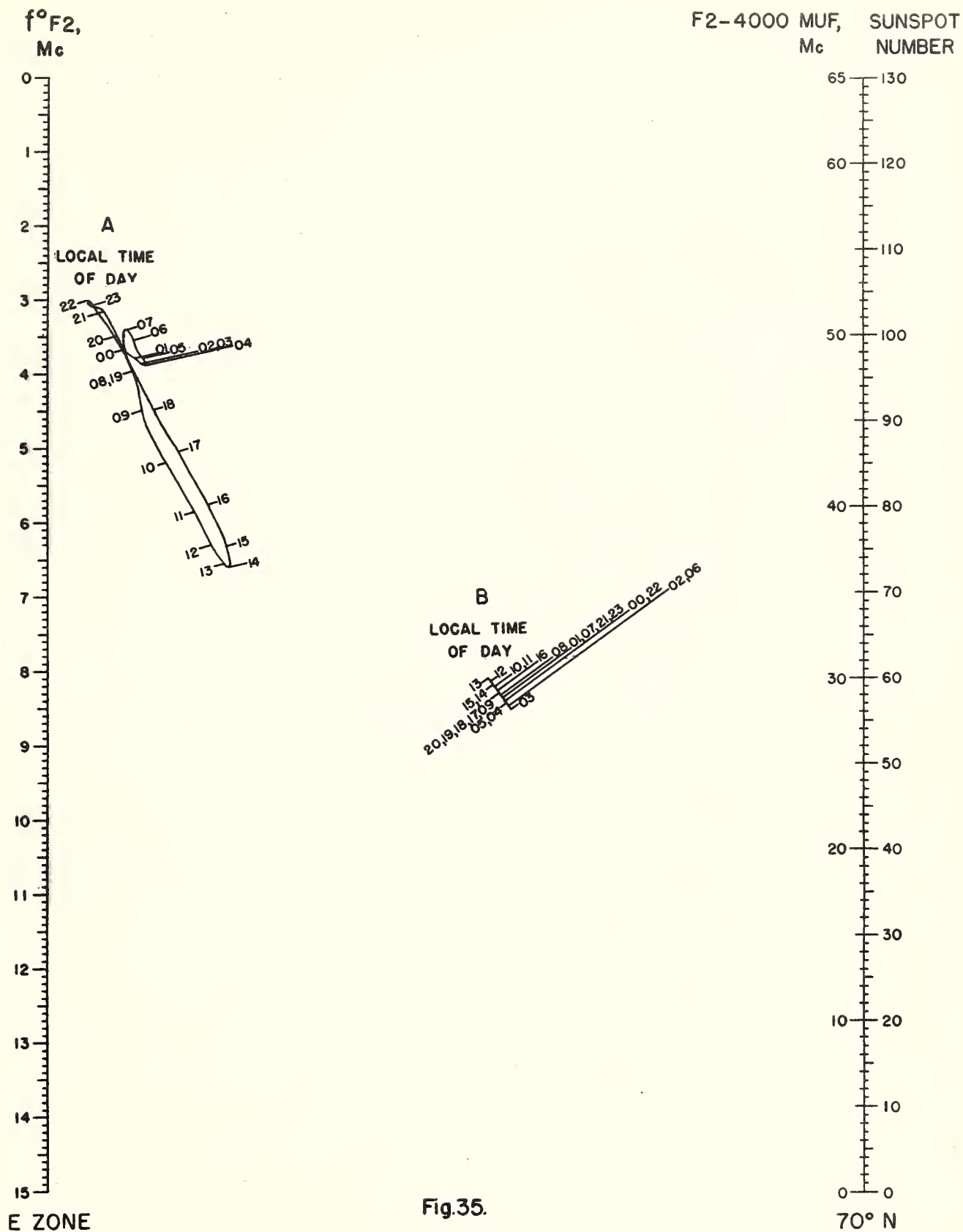


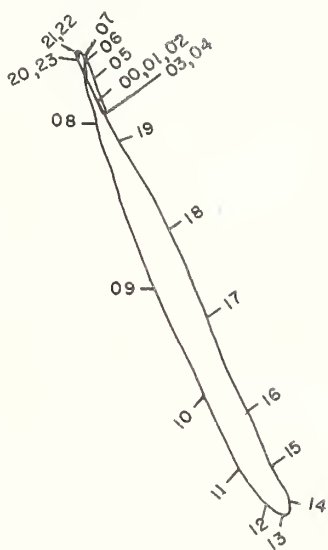
Fig.35.
JANUARY

$f^{\circ}F_2$,
Mc



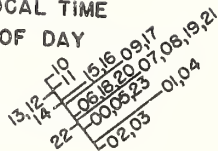
E ZONE

A
LOCAL TIME
OF DAY



B

LOCAL TIME
OF DAY



F2-4000 MUF, SUNSPOT
Mc NUMBER

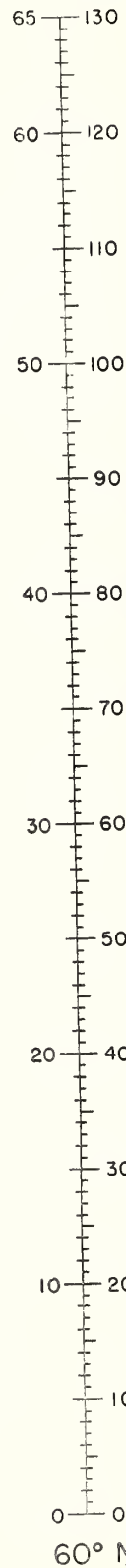
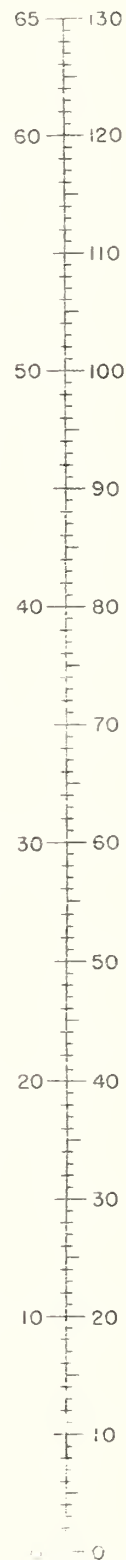
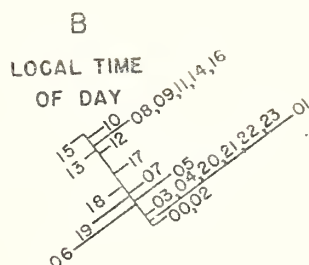
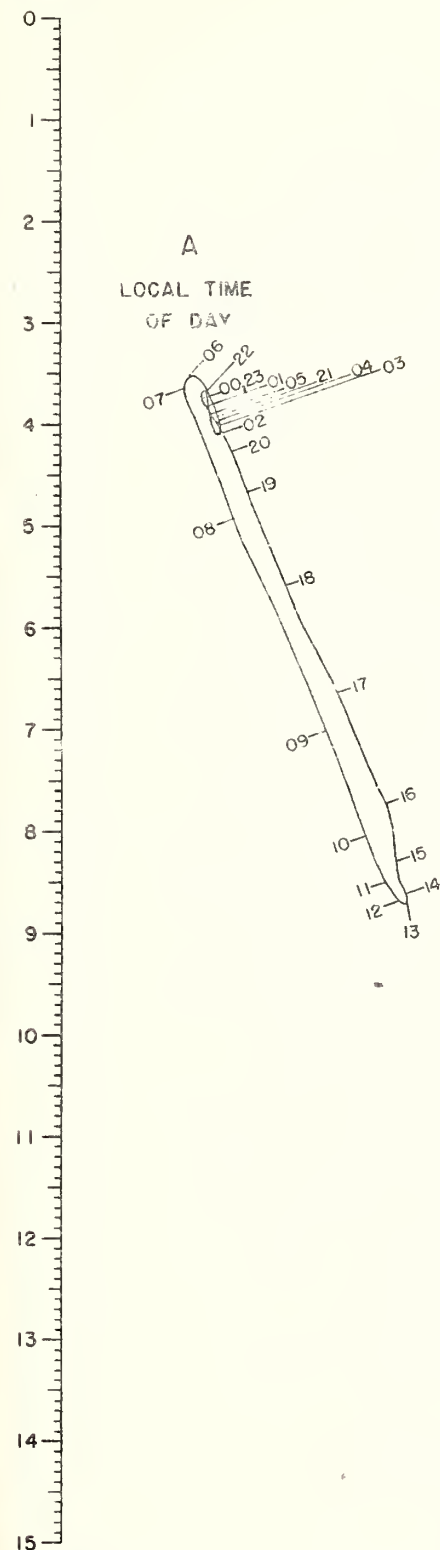


Fig.36.
JANUARY

f^oF_2 ,
Mc

F2-4000 MUF, SUNSPOT
Mc NUMBER



E ZONE

Fig 37
JANUARY

50° N

$f^{\circ}F_2$,
Mc



E ZONE

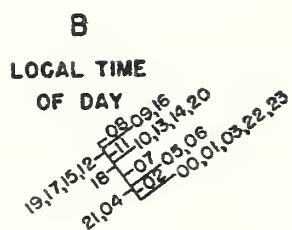
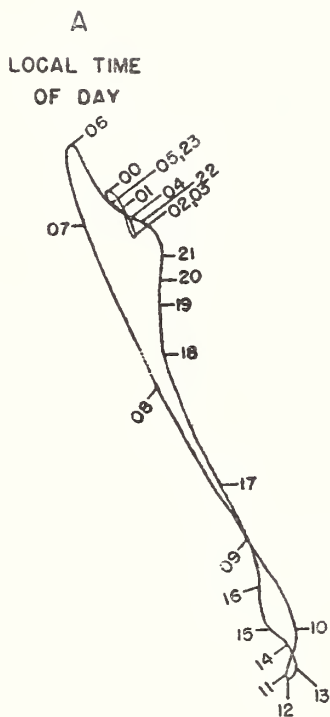
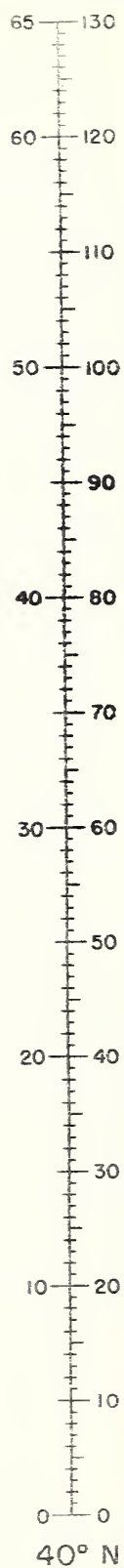


Fig.38.
JANUARY

F2-4000 MUF, SUNSPOT
NUMBER



40° N

F2-4000 MUF, Mc	SUNSPOT NUMBER
--------------------	-------------------

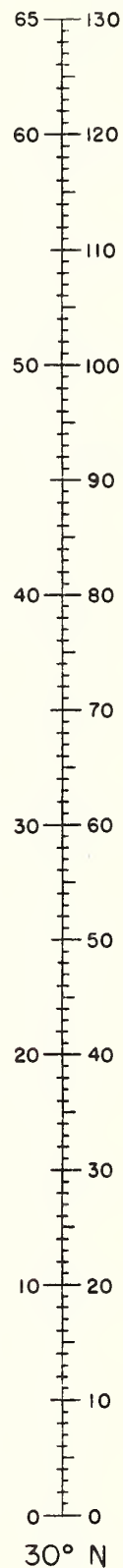
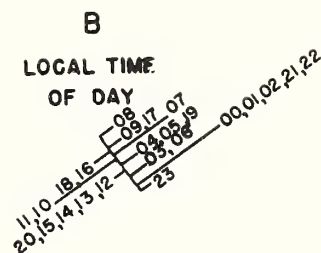
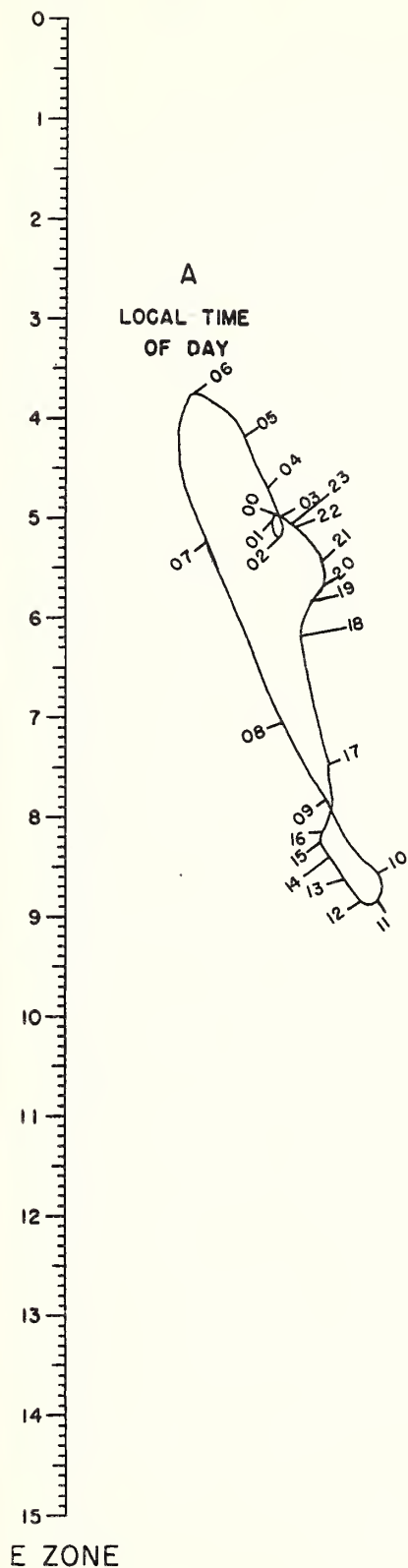
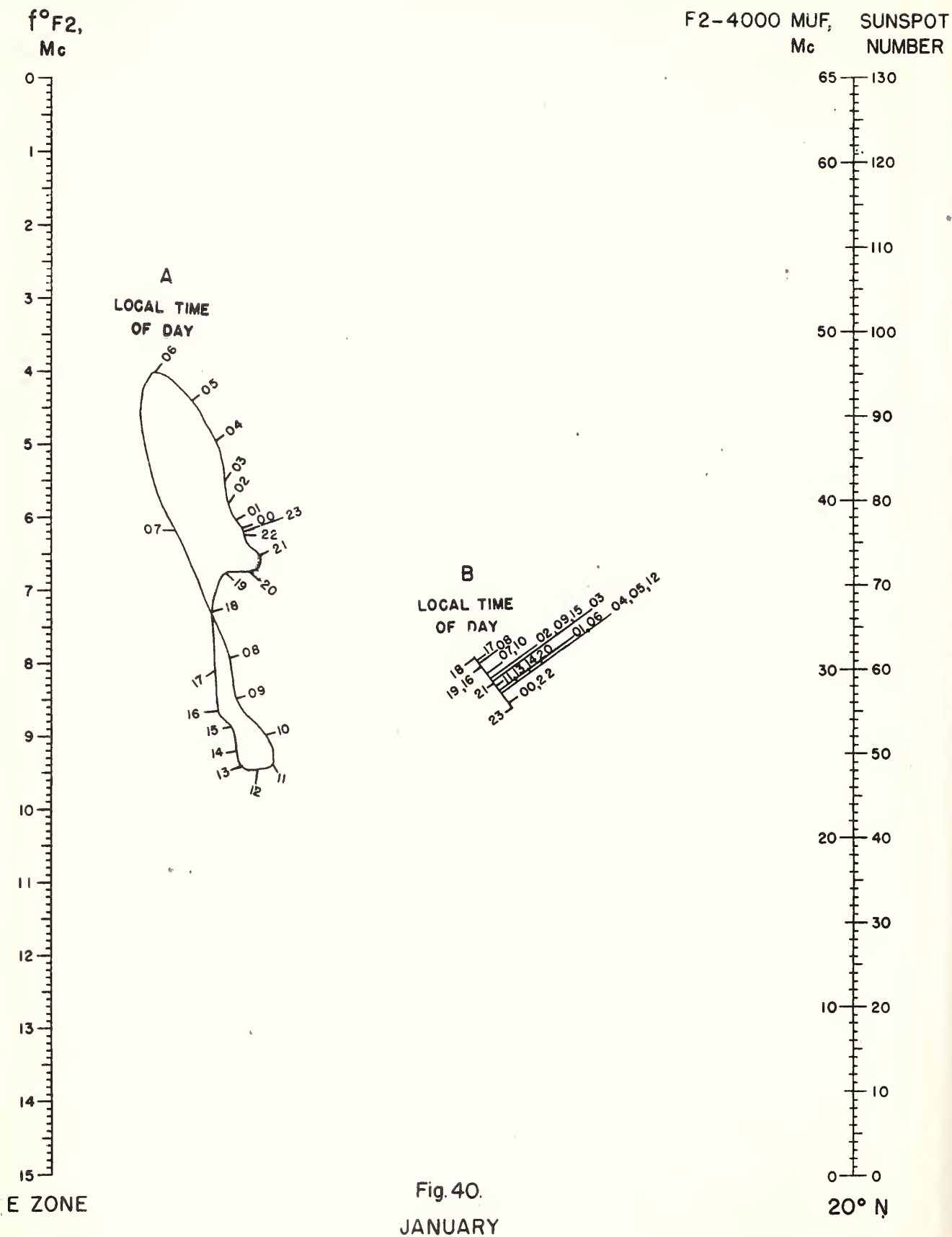


Fig.39.
JANUARY



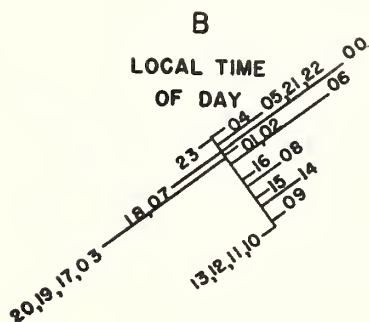
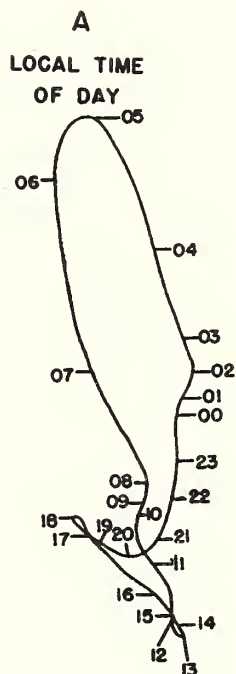
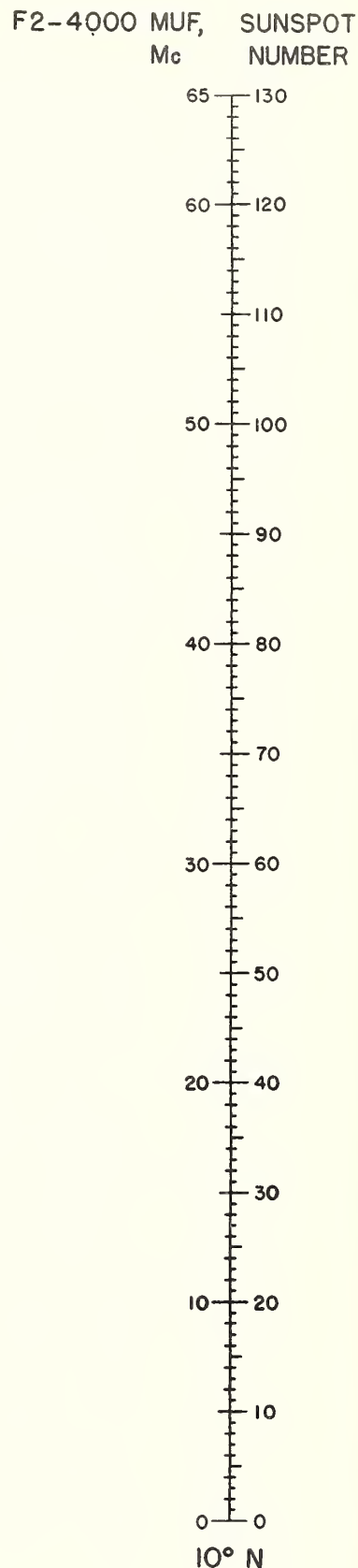
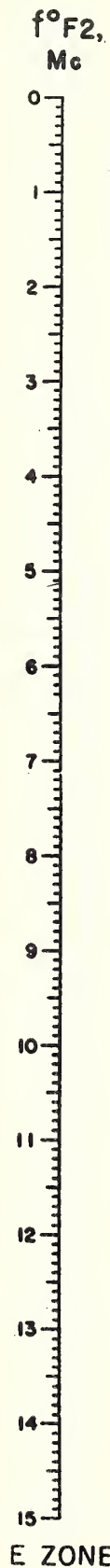


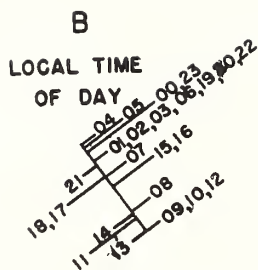
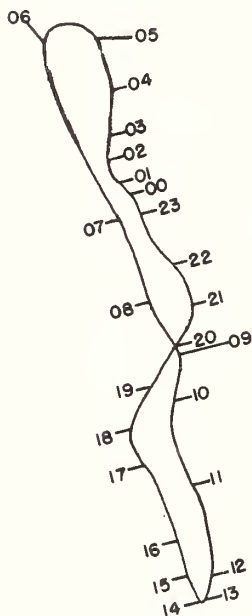
Fig. 41.
JANUARY

f^oF_2 ,
Mc

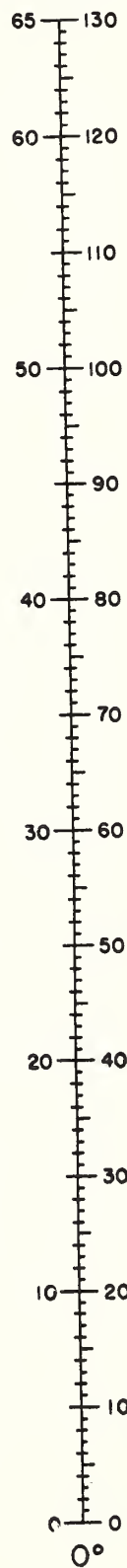


E ZONE

A
LOCAL TIME
OF DAY



F2-4000 MUF,
Mc

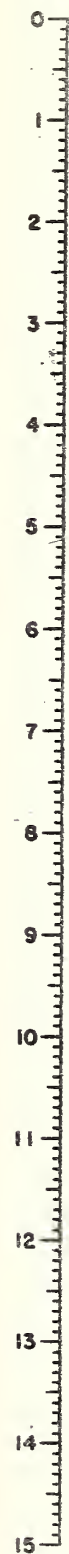


SUNSPOT
NUMBER

Fig.42.
JANUARY

f°F2,
M₃₀₀₀

F2-4000 MUF, SUNSPOT
M₃₀₀₀ NUMBER



E ZONE

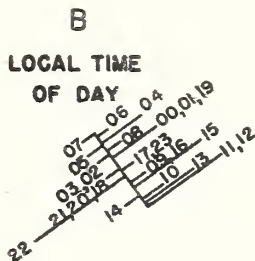
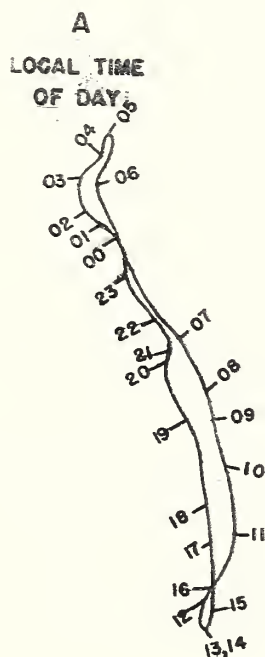
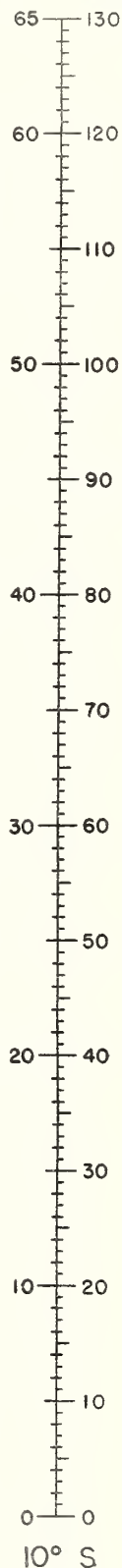


Fig.43.
JANUARY

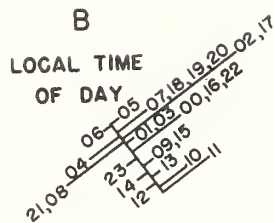
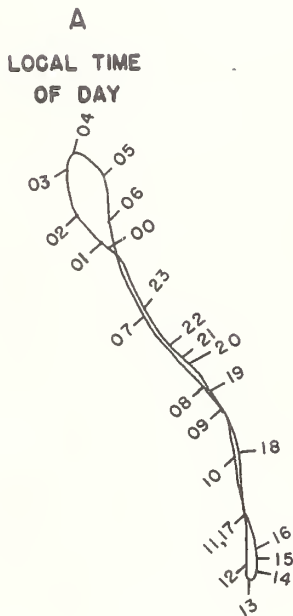


10° S

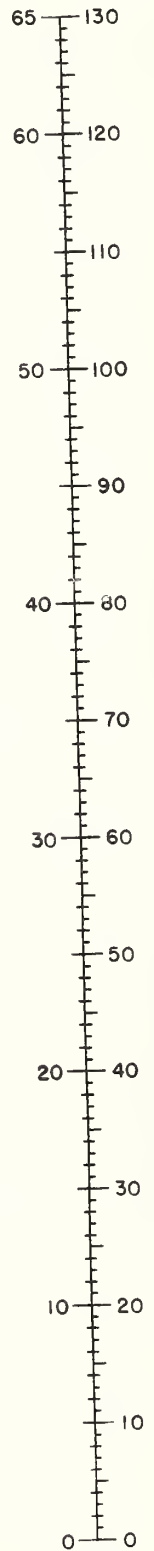
$f^{\circ}F_2$,
Mc



E ZONE

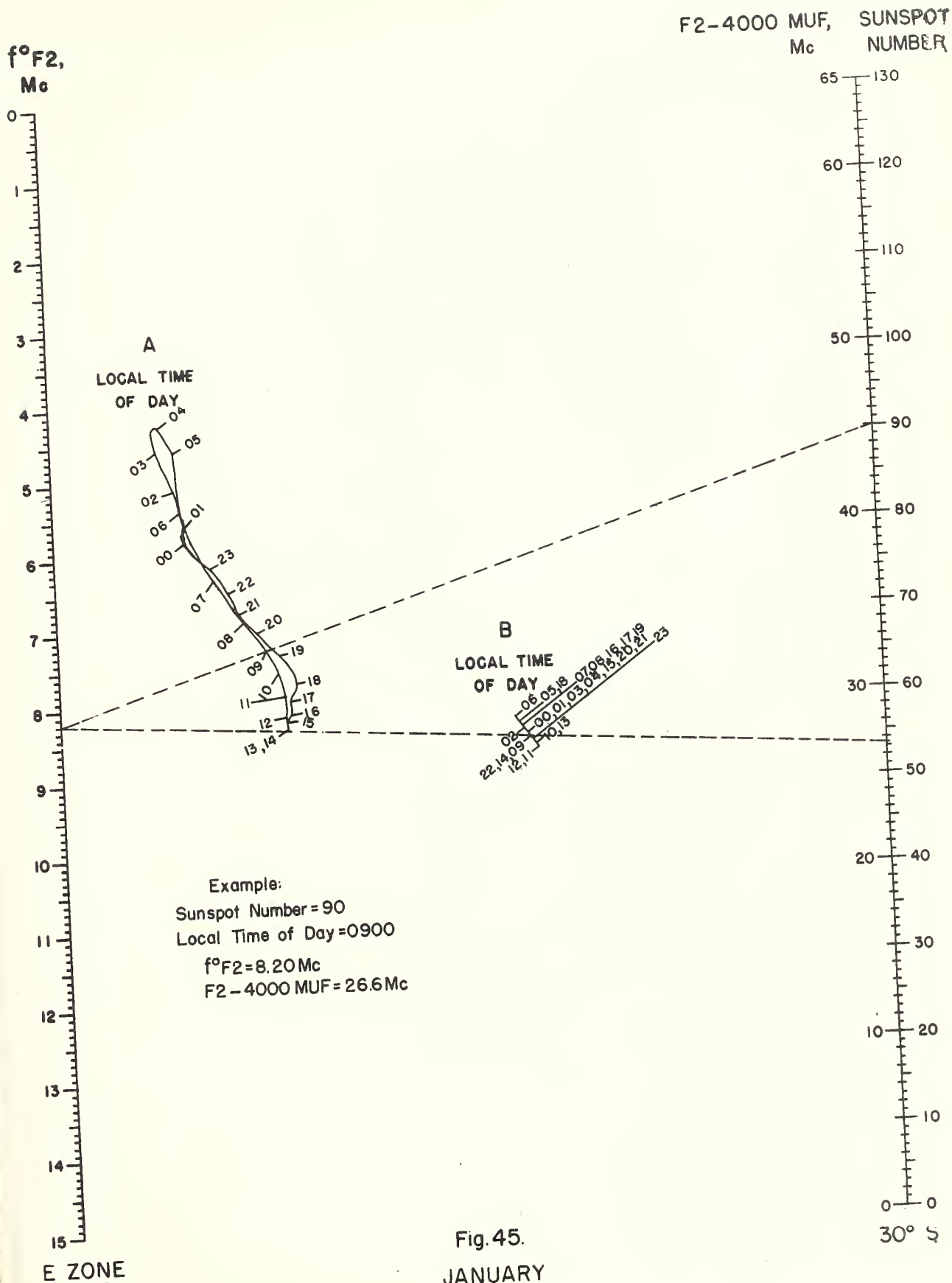


F2-4000 MUF, Mc SUNSPOT
NUMBER



20° S

Fig44
JANUARY



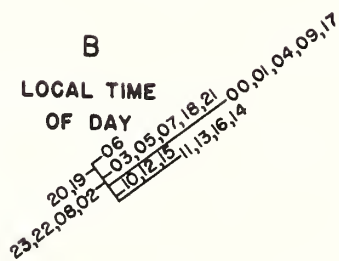
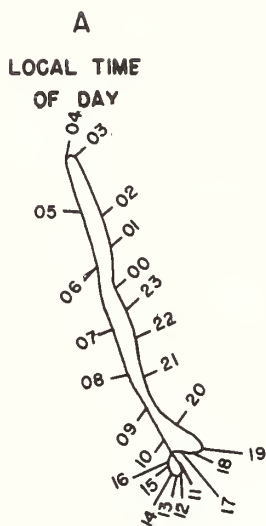
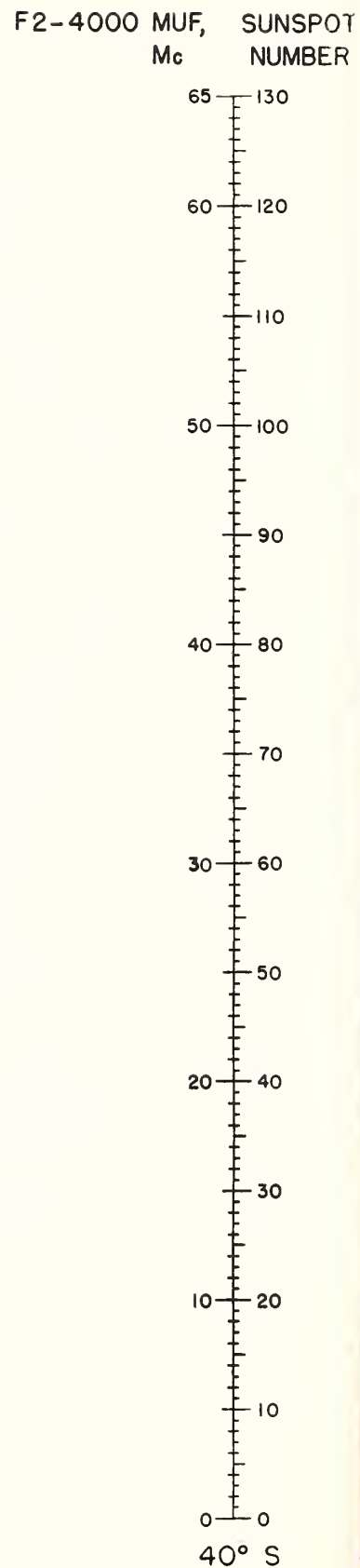
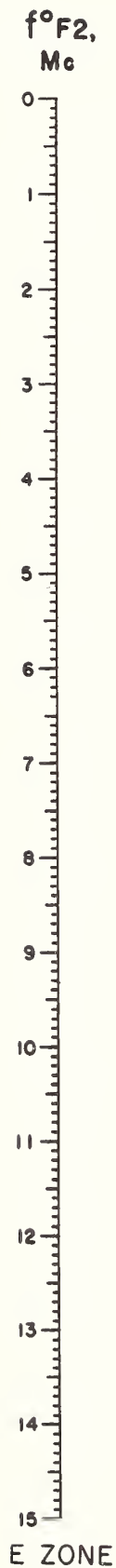
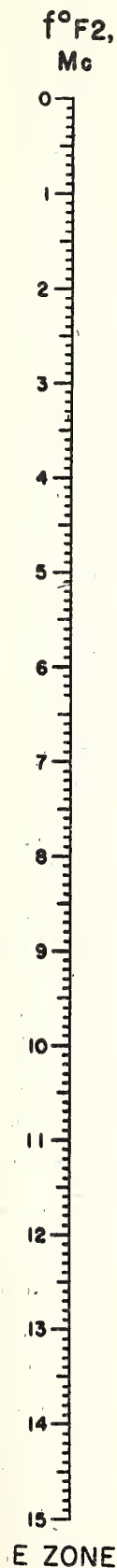


Fig. 46.
JANUARY



F2-4000 MUF, SUNSPOT
 M_c NUMBER

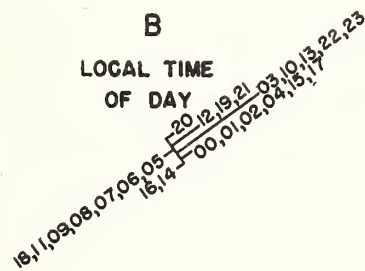
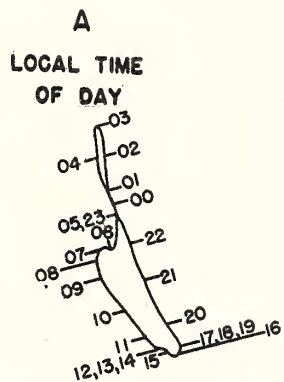
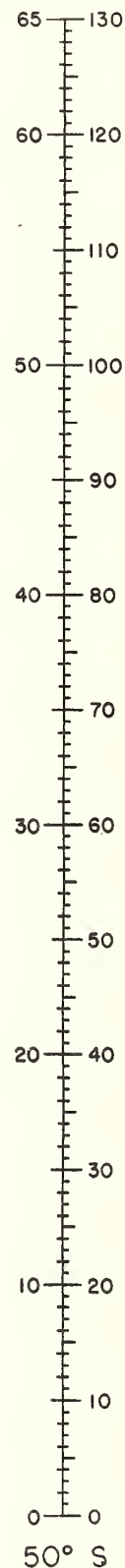
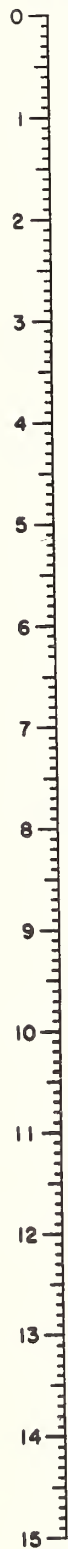
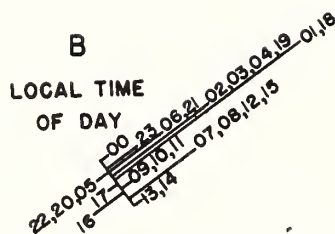
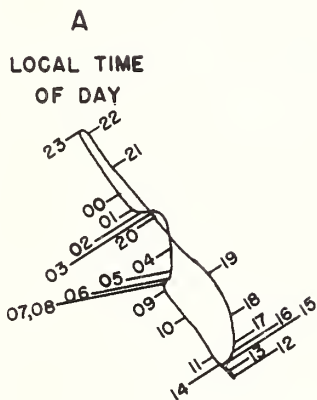


Fig. 47.
JANUARY

f^oF_2 ,
Mc



E ZONE



F2-4000 MUF, SUNSPOT
Mc NUMBER

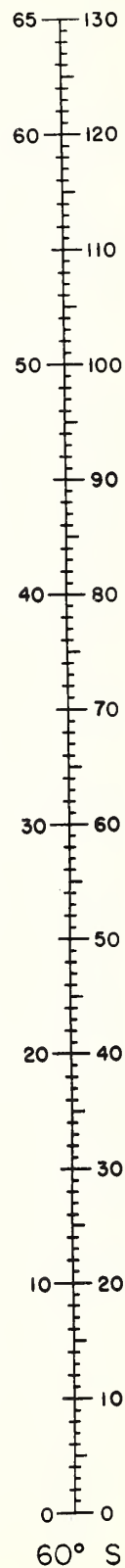
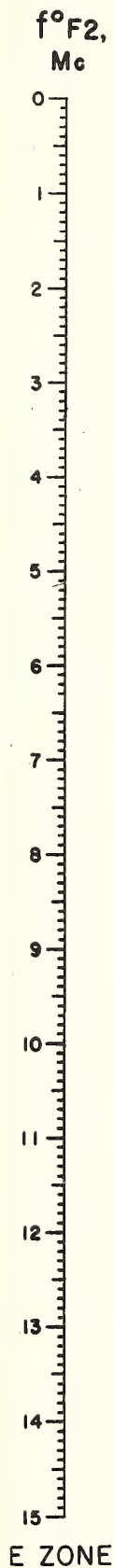


Fig.48.
JANUARY



E ZONE

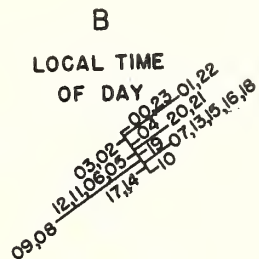
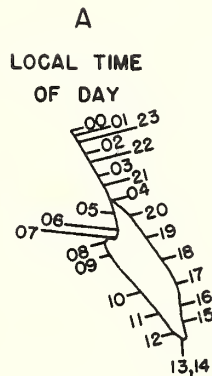
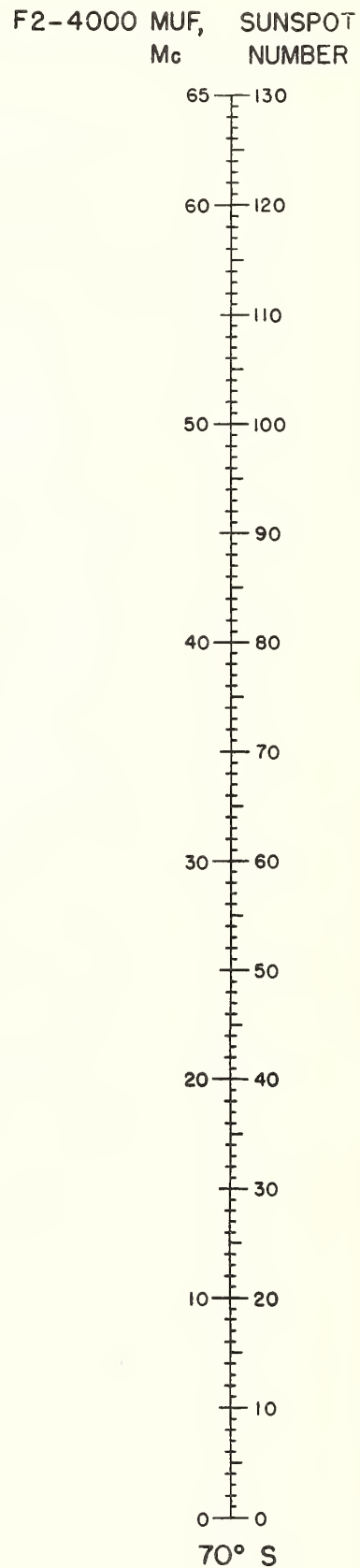


Fig.49.
JANUARY



70° S

$f^{\circ}F_2$,
M₃₀₀₀



F2-4000 MUF, SUNSPOT
M₃₀₀₀ NUMBER

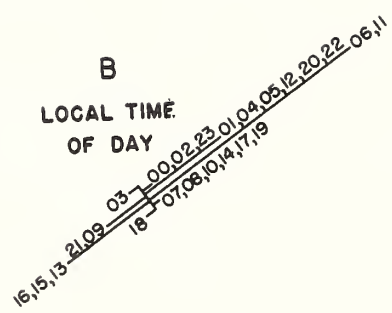
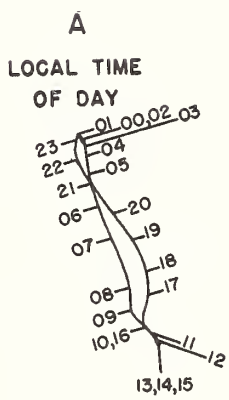
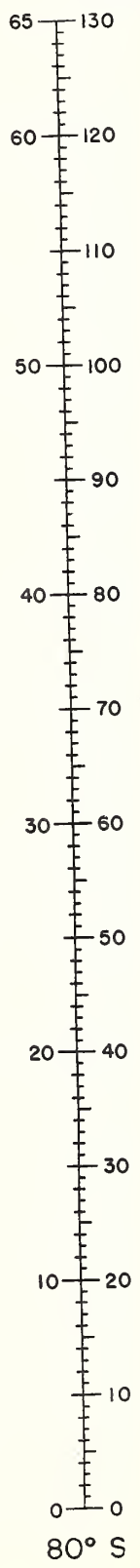


Fig.50.
JANUARY